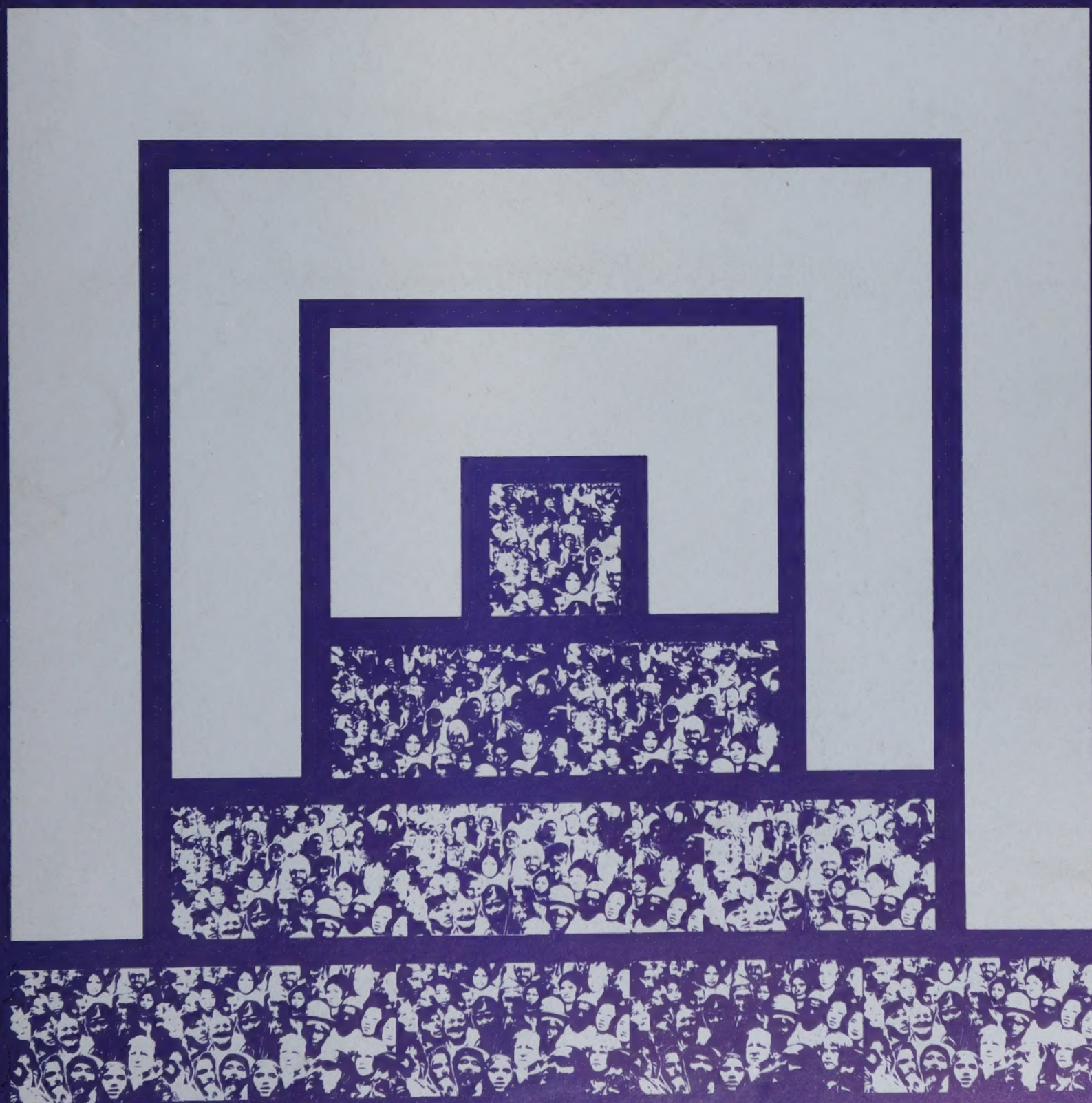


International Conference on Population, 1984

# Population, Resources, Environment and Development

Proceedings of the Expert Group on Population, Resources,  
Environment and Development. Geneva, 25-29 April 1983



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# Population, Resources, Environment and Development

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Proceedings of the Expert Group on Population, Resources,  
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United Nations  
New York, 1984



## EXPLANATORY NOTE

The following symbols have been used in tables:

Three dots (...) indicate that data are not available or are not separately reported.

A dash (--) indicates that the amount is nil or negligible.

The following abbreviations have been used:

CSDHA	Centre for Social Development and Humanitarian Affairs
ECA	Economic Commission for Africa
ECE	Economic Commission for Europe
ECLAC	Economic Commission for Latin America and the Caribbean
ESCAP	Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
ILO	International Labour Organisation
OECD	Organisation for Economic Co-operation and Development
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Fund for Population Activities
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization
WMO	World Meteorological Organization

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The designations "developed" and "developing" economies are intended for statistical convenience and do not, necessarily, express a judgement about the stage reached by a particular country or area in the development process.

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## PREFACE

The Economic and Social Council, in its resolution 1981/87 of 25 November 1981, decided to convene an international conference on population in 1984 under the auspices of the United Nations, to be devoted to the discussion of selected issues of the highest priority, giving full recognition to the relationships between population and social and economic development with the aim of contributing to the process of review and appraisal of the World Population Plan of Action. At the request of the Council, the Secretary-General appointed the Executive Director of the United Nations Fund for Population Activities to serve as Secretary-General of the Conference and the Director of the Population Division of the Department of International Economic and Social Affairs of the United Nations Secretariat as Deputy Secretary-General.

In the same resolution, the Council authorized the Secretary-General to convene, in preparation for the Conference, four expert groups which would be interdisciplinary and concerned with the interrelationships between economic, social and political factors in population and development with a problem-solving orientation. The expert groups were, therefore, organized by the Population Division of the Department of International Economic and Social Affairs of the United Nations Secretariat, each of which had the central task of examining critical, high-priority population issues and, on that basis, making recommendations for action that would enhance the effectiveness of and compliance with the World Population Plan of Action. The four expert groups were: the Expert Group on Fertility and Family (New Delhi, 5-11 January 1983); the Expert Group on Population Distribution, Migration and Development (Hammamet, Tunisia, 21-25 March 1983); the Expert Group on Population, Resources, Environment and Development (Geneva, 25-29 April 1983); and the Expert Group on Mortality and Health Policy (Rome, 30 May - 3 June 1983).

Contained in this volume are the report and the selected papers of the Expert Group on Population, Resources, Environment and Development, which will not only make a valuable contribution to the International Conference on Population itself but will serve as useful tools to future researchers on the relationships between population, resources, environment and development in the 1980s and on the work of the United Nations in that area.

Acknowledgements are due to the consultants, various United Nations organizations and intergovernmental and non-governmental organizations which participated in the meeting and helped in preparing the documents.

### 1. GENERAL OVERVIEW

#### A. Population, resources, environment and development: Highlights of the issues in the context of the World Population Plan of Action

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Part One

REPORT OF THE EXPERT GROUP ON POPULATION, RESOURCES,  
ENVIRONMENT AND DEVELOPMENT







## INTRODUCTION

The Economic and Social Council, in its resolution 1981/87 of 25 November 1981, decided to convene an international conference on population under the auspices of the United Nations to discuss selected issues of the highest priority, giving full recognition to the relationships between population and social and economic development with the aim of contributing to the process of review and appraisal of the World Population Plan of Action 1/ and to its further implementation. The Council also authorized the Secretary-General to convene four expert groups as part of the preparatory activities.

Pursuant to that resolution, the Secretary-General convened the Expert Group on Population, Resources, Environment and Development from 25 to 29 April 1983. The meeting took place in the Palais des Nations at Geneva, Switzerland, in co-operation with the Development Policy Forum of the German Foundation for International Development.

The participants included the following experts, attending in their personal capacity:

Ester Boserup, Casa Campagnola, Nevedone, Brissago, Switzerland

Philippe de Seynes, Director and Senior Special Fellow, United Nations Institute for Training and Research, New York, New York, United States of America

Erik Eckholm, Managing Editor, Natural History, American Museum of Natural History, New York, New York, United States of America

Hans-Rimbert Hemmer, Department of Economics and Development, Justus-Liebig University, Giessen, Federal Republic of Germany

Amilcar Herrerá, Director, Institute de Geociencias, Universidade Estadual de Campinas, Campinas, Brazil

Lars Ingelstam, Department of Technology and Social Change, University of Linköping, Linköping, Sweden

Nathan Keyfitz, Harvard University, Center for Population Studies, Cambridge, Massachusetts, United States of America

Fernando Magalhães, Divisao das Nações Unidas, Ministerio das Relações Exteriores, Brasília, Brazil

Mahar Mangahas, Development Academy of the Philippines, Metro Manila, Philippines

A.C. Mascarenhas, Institute of Resource Assessment, University of Dar Es Salaam, Dar Es Salaam, United Republic of Tanzania



Roger Revelle, University of California, San Diego, La Jolla,  
California, United States of America

Ignacy Sachs, Maison des Sciences de l'Homme, Paris, France

Osvaldo Sunkel, Economic Commission for Latin America, Santiago,  
Chile

The participants also included representatives of the Population Division of the Department of International Economic and Social Affairs of the United Nations Secretariat; representatives of the following regional commissions of the United Nations: the Economic Commission for Europe, the Economic and Social Commission for Asia and the Pacific, the Economic Commission for Latin America and the Caribbean, the Economic Commission for Africa, and the Economic Commission for Western Asia; representatives of the following United Nations bodies: the United Nations Centre for Human Settlements, the United Nations Conference on Trade and Development, the United Nations Environment Programme, the United Nations Industrial Development Organization, the United Nations University; representatives of the following specialized agencies: the International Labour Organisation, the Food and Agriculture Organization, the United Nations Educational, Scientific and Cultural Organization, the World Health Organization, the World Bank, the World Meteorological Organization; a representative of the following intergovernmental organization: the Organisation for Economic Co-operation and Development; and representatives of the following non-governmental organizations: African Institute of Economic Development and Planning, Committee for International Co-operation in National Research in Demography, the Institute of the Sahel, International Institute for Environment and Development, International Planned Parenthood Federation, International Social Security Association, International Union for the Scientific Study of Population, International Union for the Conservation of Nature and Natural Resources, National Audubon Society, The Population Council and the Population Institute. There were two observers. The participants represented a broad range of geographical regions, scientific disciplines and institutions concerned with questions of population, resources, environment and development.

As bases for discussion, four experts prepared papers on the main items of the agenda, shown in annex I below. The organizations participating in the meeting submitted papers on the several topics. A list of papers made available to the Expert Group appears in annex II.

The meeting was opened by Rafael M. Salas, Secretary-General of the International Conference on Population, 1984. He thanked A.G. Friedrich, Chairman of the Policy Forum of the German Foundation for International Development for their generous financial support and for their untiring efforts in making preparations for the meeting.

Mr. Salas drew the attention of the participants to the fact that awareness of the many interrelationships between population, resources, environment and development has greatly increased during the past decade. But he also emphasized the need for a more accurate knowledge of the causal links existing between the various factors involved in order to achieve more



refinement in designing policies to solve the problems caused by these interrelationships, and he suggested that during the forthcoming discussions three main points should be kept in mind: first, there would be a substantial growth of the world's population between now and the year 2000, and between 2000 and the time when that population would be stabilized, probably near the end of the next century. Second, the problems associated with these interrelationships should not be allowed to deflect the developing countries from the path of development they had chosen. And third, an equilibrium between population and subsistence, acceptable to the majority, could be reached only if "All countries and within them all social sectors should adapt themselves to more rational utilization of national resources without excess, so that some are not deprived of what others waste".

Mr. Salas also gave some examples of specific questions that should be addressed by the group in order that Governments should have a sound basis on which to make appropriate decisions. Food production for the world as a whole might be sufficient to meet the needs of a growing population, but would the geographical distribution of food production make it impossible to meet national and local needs? Was it possible to work out a policy to minimize the effects of fertilizer and pesticide on the environment of these countries? Would the development of human resources in developing regions permit the transfer of technologies from industrialized countries?

Making people more efficient agents of the development process, he emphasized, was central to the discussions of the interrelations between population, resources, environment and development. Furthermore, the role of technology in integrating these interrelated factors appeared to be critical and needed further research. Finally, as long as there were disparities in standards of living and in life-styles, the problems of interrelationships would persist and little improvement in the well-being of the underprivileged was likely. Like resources and the environment, development should be considered as a collective responsibility of the international community. The Secretary-General of the Conference concluded by expressing his hope that the discussions and recommendations of this meeting would be of considerable help to the participants of the 1984 International Conference on Population in identifying critical issues and setting out guidelines and recommendations for research and action.

A.G. Friedrich, Chairman of the Development Policy Forum of the German Foundation expressed his appreciation to the Secretary-General of the Conference for the preparatory work done by the United Nations. He informed the participants of the main areas of interest of the Foundation's Policy Forum which include population issues and industrialization, world food security and cultural relations. Mentioning also the Foundation's involvement in projects on interregional co-operation, Mr. Friedrich concluded by stating that the interrelations between population, resources, environment and development were of great interest to the Foundation and that he looked forward to discussions of such a complex and difficult subject.

The Deputy Secretary-General of the Conference, Léon Tabah, stressed the importance of this meeting, stating that it should set the general tone for the discussions that would take place at the International Conference on



Population to be held in Mexico City in 1984. Noting the continuity between what had been accomplished in Bucharest and current studies, he also emphasized that much had transpired in the years since 1974 and therefore that a general reassessment of the thinking about population was in order. The results of the Expert Group Meeting would provide an invaluable basis for the assessment.

Emphasizing the extreme complexity of the subject, the Deputy Secretary-General stressed the importance of an approach to the discussion of the issues which was neither too general nor too specific. He indicated that the central theme of the Meeting should be the linkages between population and development, taking into account their relationship to resources and the environment. He added that in spite of an imperfect knowledge of the causal links existing between the various phenomena involved, it was clear that the interrelationships should be studied in a systemic or holistic manner. This systemic approach implied that intervention to correct negative effects of the interrelations between population, resources, environment and development should be envisaged in a dynamic way and should make use of a combination of factors. He added, parenthetically, that another prerequisite for effective intervention was due consideration of the temporal dimension: in particular, delayed intervention might come too late to reverse certain trends.

Mr. Tabah concluded by mentioning that though they took different forms the problems to be discussed in this Meeting were shared by all countries, both developed and developing. In particular, the deterioration of the world environment and the depletion of natural resources transcended national boundaries. Furthermore, these immediate problems might also have some positive consequences: they might lead to a general recognition that a system for monitoring interrelated trends was urgently needed, and that the information derived from such a system could become the basis for relevant policy research. There was also a growing awareness among the international community that the solutions of the already identified problems required the participation of all countries concerned, and that out of this awareness, new international rights and obligations might emerge.

The Expert Group adopted the proposed agenda for the Meeting (see annex I). Although a topical approach was chosen, it should be stressed that each issue dealt with a selected example of a key problem area, which was best understood as an aspect of a holistic and synergistic set of interrelationships. The primary goal of the Meeting was to achieve a more precise identification of the role of population within these interrelationships; that is, to identify mechanisms through which population characteristics conditioned and were conditioned by resource use, environmental effects and the development structure. This required a systems approach in which all factors were treated simultaneously and in which the closing of loops through feedback effects was of foremost importance.

It was intended that results of the Expert Group's deliberations would provide a substantive basis for the review and appraisal of those aspects of the World Population Plan of Action which dealt with the interrelationships between population, resources, environment and development. Though the Plan of Action contained little that dealt explicitly with the interrelationships,



it recommended policy measures for dealing with the supply of food and stressed the need for a rational utilization of resources, improving the quality of the environment, a more equitable distribution of income, the attainment of full employment, increasing investments in health and education and the provision of adequate social security for the aging, all of which were subjects contained in the agenda of the Meeting.

The Expert Group Meeting elected five co-chairmen: Ester Boserup, Enrique Iglesias, Milos Macura, A.C. Mascarenhas and Philippe de Seynes. Amilcar Herrera was designated General Rapporteur. David E. Horlacher of the Population Division of the United Nations Department of International Economic and Social Affairs was the Technical Secretary. The following participants acted as discussion leaders: Ester Boserup, Svend Brogger, Juan Casassus, Paul Demeny, Erik Eckholm, H.R. Hemmer, Amilcar Herrera, Lars Ingelstam, Nathan Keyfitz, Mahar Mangahas, A.C. Mascarenhas, Roger Revelle and Gerry Rodgers. Participants serving as Rapporteurs for individual sessions were: Ester Boserup, Erik Eckholm, H.R. Hemmer, Lars Ingelstam, Nathan Keyfitz, Milos Macura, Fernando Magalhães, Mahar Mangahas, A.C. Mascarenhas, Ignacy Sachs and Osvaldo Sunkel.

The first item of the agenda called for a general discussion of past and future trends in population, resources, environment and development. The Expert Group emphasized the need for better knowledge of how the trends of the various variables interacted and modified each other and particularly about the role of population within the interrelationships.

The discussion of food and nutrition centred on the demographic, economic, social, political and institutional aspects of meeting the needs for food and nutrition, while the physical aspects were given greater attention in the discussions of resources and environment. At the centre of the deliberations were such issues as poverty, the food versus feed controversy, food self-sufficiency and particularly the role of population growth.

The discussion on resources and the environment covered the resource base, environmental degradation and non-renewable resources. Attention was centred on the various mechanisms that could expand resource availability as well as those activities that had caused a degradation of the environment.

The discussions of social and economic aspects of development involved four interrelated topics: (a) income distribution, (b) employment, (c) health and education and (d) social security. With regard to income distribution, stress was given to the role of changing rates of population growth in altering the distribution of income and wealth. In discussing employment, the Expert Group considered a number of alternative approaches by which countries with rapidly growing labour forces could create high productivity employment with adequate rates of remuneration. With regard to health and education, the discussion focused on the interactions between investments in human capital, and changes in demographic and development variables. Finally, discussions of social security considered the problems of meeting the needs of aging populations in both developed and developing countries. It was pointed out that as age structures of populations change, the burden of providing sufficient income and medical care to the aged would become an increasingly severe problem.



The last substantive items on the agenda addressed the issue of integrated planning and policy formation. It was stated that though progress had been made in connection with the development of institutional frameworks for the integration of population factors into development planning, this process had been hindered by such factors as inadequate understanding of population-development interrelationships, limitations in the existing planning methodology, and lack of expertise in this area. In the area of demographic policy-making, stress was laid on fertility decline as a means of slowing population growth.

It was noted that in the Symposium on Population, Resources, Environment and Development held in 1973 prior to the Bucharest Conference of 1974, there was a division among the participants into those who were concerned by what seemed to be explosive population growth in the context of very confining limits to growth and those who saw the main obstacles to sustained development as essentially socio-political and institutional. The present Expert Group generally took the view that explosive population growth would gradually decelerate towards stability and that environmental catastrophe was unlikely; they accepted the view that the socio-economic and political barriers to development remained the most difficult to overcome. Rather the Expert Group was divided along different lines. Some were more concerned with immediate problems. Viewing demographic trends as largely exogenous, they gave highest priority to finding the best way to accommodate the needs of growing populations. Others emphasized long-run problems and considered demographic trends as possible policy instruments for dealing with problems of resources, the environment and development.

## I. Trends in population, resources, environment and development

### A. Introduction

Before examining the policy issues arising out of the complex interactions between population, resources, environment and development, the Expert Group reviewed past trends and their likely future course in each of the four areas, taking into account not only the evolving concepts in each of these areas but also the need to consider population, resources, environment and development as a unified structure.

The Chairman, at the outset reminded the Expert Group of the importance of adopting a broad integrative approach to the subject. For example, the concept of carrying capacity should not be confined to a consideration of physical limits. The concept of environment should include social as well as ecological dimensions; and the concept of development should be considered in more than its economic dimensions. Other important aspects which must be kept in mind were : social justice and the relations between nations. In this regard the Chairman noted that the concept of "styles of development" could provide the necessary framework for pursuing an integrated approach to the analysis of problems involving interactions between population, resources, environment and development.

### B. Population

The Expert Group noted that an analysis of the population factor must consider many other variables in addition to the number of persons, their location, age and sex composition. It must also encompass important socio-economic characteristics such as income distribution, levels of education, health and family status. Therefore a study of population problems should extend beyond questions of high fertility, high mortality and rapid rates of migration and should include such factors as levels of nutrition, security in old age and the status of women.

In this regard it was noted that the United Nations General Assembly had substituted the term "people" for "population" in the interrelations exercise. And that term could have been replaced by "society" in recognition of the fact that a population interacts with the environment and the natural resource base through its social institutions. The terms "people" and "society" served as a reminder that the concern of the Expert Group was for the welfare of individuals organized into social units.

The discussions of the Expert Group were profoundly influenced by an awareness that in the decade between 1970 and 1980, world population had grown from 3.7 to 4.4 billion and were projected to reach 6.1 billion by the year 2000, and approximately 10.5 billion before achieving stability shortly after the end of the next century. The Expert Group observed, however, that declining growth rates were no cause for complacency since the absolute annual increments to world population would continue to be very large for many years to come. Furthermore there was a great difference between trends in the



developed and the developing countries. In the former the annual growth rate was .7 per cent in 1980, whereas in the developing countries the annual growth rate was 2.1 per cent. As a consequence the proportion of the world population living in the less developed countries would increase from about three fourths in 1980 to four fifths in the year 2000.

The Expert Group also noted that for the world as a whole, there had been a decline in the proportion of the population who were very young, and a concomitant rise in the average age of the population, a trend which was expected to continue well beyond the year 2000. The aging of world population was likely to result in a decline in the overall dependency ratio. Nevertheless in the developed countries the number of persons aged 60 years and over would have increased by 30 per cent between 1975 and 2000. The Expert Group also noted that at present the developing countries accounted for just over half of all persons over age 60 and that this figure was projected at 60 per cent by the end of the century.

Changes in the size and age composition of the population would be accompanied by changes in its urban-rural distribution. Between 1975 and 2000 the world's urban population was projected to double. At the end of the period approximately half the world's population would be urban.

Since population projection models generally failed to take into account the implications for demographic variables of alternative patterns of economic, social, political, technological and environmental development, the Expert Group concluded that one should not assume that the future population profile was known and that all the uncertainties lay in the areas of resources, the environment and development.

The Expert Group agreed that though long term prospects indicated a deceleration in population growth, continued rapid population increase in the less developed countries was virtually certain for the remainder of this century. But there was no consensus among the experts with regard to long-range projections which implied that all national fertility patterns would converge towards replacement levels. Several participants expressed the view that it could not be demonstrated that such a convergence was assured or even highly probable, noting that in Sub-Sahara Africa and in much of South Asia, fertility decline had not yet begun. Though previous research suggested that the achievement of development goals should eventually reduce rates of population growth, even these reduced rates could generate large absolute increments to the world population.

Furthermore it was noted that the world was undergoing a period of minimal economic growth during which the process of demographic transition was not likely to be carried forward, unless there were appropriate modifications towards a more egalitarian strategy of development. Therefore some participants argued that projections of a convergence towards replacement levels of fertility were really normative statements that suggested a timetable against which the actual time-path of demographic variables could be measured.



The large future populations of some developing countries implied by long range demographic projections were also challenged. It was asserted that social and technical changes of unprecedented scope would be required if anything near the projected population totals were to be reached; and that an assessment of the resource situation might well lead to downward adjustment of long-run demographic projections. In contrast to this, others expressed the view that in much of the developing world resource constraints were likely to remain inoperative as a regulator of population growth for many decades to come.

It was also observed that the long-term demographic paths of nations were not independent of their political histories and of the resulting socio-economic changes. And therefore long-term population trends could not be accurately projected without examining realistic scenarios of possible social reforms.

The Expert Group noted that in the years since the 1974 World Population Conference in Bucharest, there had been a steadily increasing recognition by countries of the importance of the interrelations between demographic change and socio-economic development. In many countries this had resulted in the formulation of explicit population policies and the creation of institutions to promote the integration of population factors into policy-making and planning for socio-economic development. And to an ever-increasing degree, Governments had undertaken to provide families with the necessary information and means to decide responsibly questions of family size.

The countries of the Asian region had led the way in pursuing policies for reducing rates of population growth. Thus the Third Asian and Pacific Population Conference in Colombo called for "reducing birth and death rates in order to attain low levels as early as possible and to attain replacement fertility by the year 2000".

Conversely, there had been renewed interest in the socio-economic implications of low fertility, a matter which was of increasing concern to the Governments of the developed countries.

### C. Resources

The Expert Group agreed that the concept of resources should not be limited to material resources drawn directly from nature but should include capital goods and human resources as well. Furthermore, it was agreed that the resource base could be viewed as an aspect of the environment, an ecosystem which both supplied resources and acted as a repository for wastes. In addition, the notion of what constituted a resource was defined by the current state of technology. Objects of little value might be converted into significant resources as a result of technical advances. The view was expressed, however, that a fundamental distinction should be made between those resources that tended to increase with the expansion of human societies and natural resources that tended, on the contrary, to be strained by that expansion. It was also noted that as a result of the increase in population, Governments were realizing that they must manage their environment in such a way as to preserve or to augment the resource base.



A resource of great concern to the Expert Group was the labour force, since it represented another aspect of population considered both in its quantitative and in its qualitative dimensions. The world's labour force was projected to grow by one third between 1980 and the year 2000. During this period the average annual growth rate of the labour force in the developing countries would be 2.6 per cent. In the developed countries, however, the rate of growth of the labour force had declined and might even become negative. Contributing to this trend were the aging of the population and the already high rate of participation of women in the labour force.

The Expert Group was aware that in recent years projected rates of economic growth had not materialized in part because of a lack of resources for capital formation. There was general agreement that though the problem of increasing capital shortage was more visible in the industrial countries, it was even more serious in the developing countries where new capital outlays were urgently required for financing the transition from oil to other energy sources, for irrigation and soil protection and for capital modernization. The Expert Group therefore noted with concern that though higher rates of investment and increased productivity of capital would be required to meet the output targets of the International Development Strategy for the Third United Nations Development Decade, recent projections indicated that rates of investment and the productivity of capital were likely to decline.

It was noted that expenditures on armaments by both developed and developing countries had diverted vast public resources away from capital formation. The significance of this diversion could be gauged from the fact that annual expenditures on arms exceeded 600 billion dollars.

Given the overwhelming significance of food and nutrition to human welfare, the Expert Group was particularly concerned with trends in the supply and productivity of arable land. It was observed that in the years between 1860 and 1978, the area of the world's farmland more than doubled. However, in the period between 1970 and 1978 the number of hectares cleared each year had declined sharply. The Expert Group also noted that the amount of farmland per person decreased significantly in both the developed and developing regions over this period. In general this was the result of increases in crop yields per hectare due to advances in agricultural technology and increases in irrigated areas.

While some lands were being put under cultivation, others were losing their fertility. Desertification were an extreme example of land degradation, and it had been estimated that desertification, if unchecked, would severely degrade an additional area twice as large as the current desert area by the year 2000. In terms of total land area damaged, most of the losses would be grasslands, but declines in soil fertility on rain-fed croplands and the waterlogging and salinization of irrigated lands took the greatest economic toll.

Erosion and degradation of topsoil was cited as a serious problem both in developed and developing countries, and especially in tropical areas because topsoils were often thinner and more fragile than in temperate latitudes, and rainfall more intense. An additional factor which had serious implications



for land maintenance were shifting cultivation. Shifting cultivation was practised by 300 million in 1980, and it was projected that this number would increase by more than 50 per cent by the year 2000, leading to further degradation of soils since sufficient empty land was often not available to permit adequate fallow periods. It was also estimated that about half of all the irrigated lands of the world had been damaged by salinization, alkalinization and waterlogging. Large areas of irrigated land had been abandoned as a result of soil salinization.

In assessing the adequacy of the world's arable land potential, the Expert Group noted that roughly half was currently under cultivation and most of the potential reserves were in Africa and Latin America. In Asia, however, nearly all the potentially arable land outside the humid tropics was already cultivated. Nevertheless, in that region, great scope existed for increasing production through irrigation and multiple-cropping.

At present, world food production was increasing by about 3 per cent per year, whereas the area of cultivated land was growing by only 0.3 per cent annually. And it was expected that future increases in food production would largely result from increased yields rather than from an extension of the margin of cultivation.

Currently closed forests and open woodlands covered about 32 per cent of world land area. In the developing countries, which contained 1.1 billion hectares of closed forests, it was expected that about two thirds would disappear by 2000, mostly because of clearing land for food production.

It was also observed that tropical rain forests had already been reduced from their natural domain by about 40 per cent. This was of special concern to the Expert Group because such forests might contain unique biological resources that could be lost forever. It was feared that if current trends in forest conversion persisted, many plant and animal species might become extinct in future decades. Moreover, temporary gains in cultivable land through forest clearance were often offset by rapid declines in soil fertility and negative effects on water retention.

The Expert Group agreed that efforts to accelerate development were not likely to be frustrated by the absolute scarcity (on a global basis) of certain non-fuel minerals. However, there was greater concern for the adequacy of fossil fuels, given their geographic distribution and the political and economic forces influencing their production and sale.

The Expert Group noted that in the years between 1950 and 1973 per capita annual production of petroleum more than tripled. Since that time, however, per capita consumption had declined in part as a result of higher prices which stimulated conservation efforts and a substitution of natural gas, coal and a variety of other energy sources for oil.

In considering the possibilities of substitution, the Expert Group noted that for the developing countries as a whole, "renewable" energy sources might be able to meet all their energy requirements at least up to the year 2025. However, it was also noted that though renewable resources were abundant in



Africa and Latin America, they could meet less than half the energy needs in 2015 for South and Southeast Asia. Furthermore, huge investments would be needed, competing for the scarce capital resources of developing countries.

## D. Environment

As noted earlier, the Expert Group employed the term environment in a broad sense to include much more than the so-called "environmental amenities". Environment was defined as the ecosystem which both supplied resources and served as a repository for the wastes. As trends in the supply of resources have already been discussed here, this section is devoted to the environment viewed as a repository of waste, or the problem of pollution.

A matter of concern to the Expert Group was the buildup of pollutants in the atmosphere, the land and the waters. An example of such a pollutant was carbon dioxide. The Expert Group noted that the amount of this chemical in the atmosphere had risen by at least 16 per cent over the last 100 years. In the past this accumulation had been due largely to the clearing of forests for agriculture, but in recent years the major cause had been fossil fuel combustion. In the 20 years prior to 1976 the atmospheric content of carbon dioxide had increased by 5 per cent, and it was expected that some time in the next century, levels would be double those that now prevail. Another atmospheric trend of concern to the participants was the apparent depletion of the ozone layer.

As a result of the broadening of the concept of the environment to include concerns for the degradation of the resource base, there had been increased interest in environmental issues on the part of all nations, particularly the developing countries. This broader concept of the environment had also fostered a recognition that technological advance not only caused environmental problems but could contribute significantly to their solution.

In assessing the prospects for the future the Expert Group recalled the findings of Wassily Leontief's study sponsored by the United Nations of the future of the world economy. Contrary to the implications of some earlier studies, he found that it would be possible to achieve development while at the same time managing environmental stresses and argued that the critical challenge to action was neither economic nor ecological but political.

## E. Development

The Expert Group agreed that development should not be defined simply in terms of increases in gross domestic product or even gross domestic product per capita but should be considered as a process of interrelated economic, social and political changes, the ultimate aim of which was to promote improvement in the well-being of the entire population. This would imply full participation in the development process and a fair distribution of its benefits.



Though economic trends constituted only a part of the developmental situation, the deliberations of the Expert Group were influenced by a pervasive sense of "crisis". It was clear that current economic trends had the effect of worsening long-term prospects rather than improving them. At the time of the Meeting the world economy was suffering from the worst recession of the post-war period. Though the rates were lower, the number of unemployed in the developed countries had risen to levels comparable to those which prevailed during the Great Depression. Furthermore, the growth rates of the developing countries had fallen to the lowest levels ever recorded, and as a result, incomes were declining for a large portion of the population of the developing countries. Meanwhile the already severe financial burdens being carried by the developing countries were worsening.

The Expert Group was aware that the decade of the 1980s followed two previous decades of decelerating rates of growth of production. The economic crisis in the 1970s which slowed the pace of development in most nations was most pronounced in the developed market economies. However, given their more rapid rate of population growth, the rate of increase in per capita income was lower in the developing countries than in the developed market economies.

The economic crisis had been particularly acute for the low-income petroleum-importing countries, which contained the majority of the total population of the developing countries. Production increases had barely exceeded rates of population growth and thus the annual rate of increase of per capita income had averaged only 1.1 per cent in the last two decades. If recent trends were to continue, the annual growth rates of production between 1980 and 2000 would average 2.6 per cent for the developed market economies and 4.8 per cent for the developing market economies. The Expert Group noted that this figure was significantly less than the 7 per cent growth rate called for by the International Development Strategy for the Third United Nations Development Decade.

The Expert Group was concerned about the great differences in levels of living between the developed and the developing countries, noting that in spite of impressive rates of growth, per capita GDP (measured in 1975 US dollars) in the developing countries had only increased from \$ 298 in 1960 to \$ 535 in 1980. In the same period GDP per capita in the developed market economies grew from \$ 3,435 to \$ 6,300; hence the relative income gap had remained approximately the same and the absolute gap had widened considerably.

In assessing likely future prospects for reducing that gap, the Expert Group noted the findings of the United Nations Industrial Development Organization (UNIDO) exercise, which indicated that the GDP per capita of the developing countries would still be less than one fifth that of the developed market countries in the year 2025. And furthermore this average figure concealed a significant disparity among regions. The Expert Group thus observed that the attainment of the Lima targets would not suffice to achieve a tolerable level of world-wide development.

Looked at from a more optimistic perspective, given the projected rates of population growth in the developing countries, their GDP per capita targets for the International Development Strategy for the Third United Nations



Development Decade would be 4.4 per cent in the 1980s and 4.7 per cent in the 1990s. Though this would only make a modest beginning towards narrowing the gap between the developed and developing countries, it was suggested that such limited progress could provide the momentum for a sustained drive towards the elimination of the worst aspects of world poverty.

This was deemed particularly urgent in light of World Bank estimates that in 1980 about 750 million people in the developing countries lived in absolute poverty. Looking ahead to the year 2000, the Bank projected that this number would fall to 630 million given rapid growth but would rise to 850 million under the slow-growth assumption.

The Expert Group noted that most developing countries were still largely dependent on exports of primary commodities, thus subjecting them to sharp and often unpredictable fluctuations in world prices, a problem that made the planning of development extremely difficult.

During the last decade, official development assistance to these countries had steadily declined from 44 per cent of net long-term flows in 1970 to less than 37 per cent in 1980. Meanwhile, there had been a doubling in the share of private bank lending, from 19 per cent in 1970 to 39 per cent in 1980. As a result, the indebtedness of the developing countries had reached a level exceeding \$ 500 billion, most of it in short-term debt at high rates of interest.

The Expert Group was also concerned with the qualitative aspects of current development trends. In particular, some participants defined the crisis as the perverse effects of having adopted inappropriate styles of development. It was their view that development styles, or more properly, patterns of development combined with life-styles and societal arrangements, played a critical role in the interrelationships and that these styles of development made for a fundamental difference in the nature and scope of the impacts on the environment and the natural-resource base of a given population size and age composition.

The structure and functioning of development styles have been the subject of intense study on the part of the Economic Commission for Latin America and the Caribbean (ECLAC). They argue that the patterns of Latin American development has had profound effects on the productive structure, the distribution of the benefits of development, emerging life-styles and demographic change.

This development style has involved a significant change in industrial structure causing the proportion of the labour force engaged in industry to increase rapidly. These changing labour requirements have stimulated increased enrolments at all levels of the educational system, particularly in higher education, which in turn has rapidly increased the size of the middle class.

Corresponding to this has been a dramatic change in Latin American agriculture. Traditional agriculture, which has been oriented towards supplying peasants with traditional foods, has in many cases been transformed



into capital, energy-and technology-intensive production for export. This process has often taken place on the best agricultural land with increasing productivity per man in agriculture but not necessarily with increased productivity per hectare. Therefore total agricultural product may not have increased and part of the labour force may have been expelled. Some labourers have migrated to arid and semi-arid lands, and to hill slopes causing rural poverty and environmental degradation; others have migrated to urban areas or even to neighbouring countries.

This development style has had a number of effects on demographic variables. The view was put forth that because it was consistent with a very high concentration of income, while a very large stratum of the population was living in extreme poverty, a high proportion of the population continued to suffer from malnutrition, thus slowing rates of mortality decline. Others, noting that this was not true for all countries of the region took issue with the conclusion of the ECLAC study.

Another aspect of this style of development is the increasing urban character of Latin American society. Furthermore, the processes of urbanization, increasing educational levels and changes in female labour-force composition, together with a rapid expansion of the middle classes, have contributed to a decline in fertility in some, but not in all, countries of the regions.

Some participants were gravely concerned about rapid urbanization noting that there was now in Latin America a social urban crisis in that there was massive unemployment in the cities due to migration from rural areas. It was argued that rural development policies should be emphasized as a means of slowing the rate of urbanization. Ideally this would involve strategies of agricultural development and the decentralization of industry.

Transnational corporations were cited as the main channel for the adoption of technology, and the main agents of production and financing in this new Latin American style of development. Therefore the Expert Group observed that the dominant power of transnational corporations should be a source of concern for developing countries. On the other hand, it was pointed out that these corporations, if their activities were appropriately controlled, could also play a beneficial role in advancing the efforts of developing countries. In addition to supplying capital, they could also provide technological and managerial expertise and create employment opportunities.

#### F. Conclusions about likely future trends

Though there was general acceptance of the view that world population growth had slowed and would cease altogether some time after 2100, this view was sharply challenged by some members of the Expert Group who felt that it would require extensive policy measures to achieve such a goal.

The Expert Group saw little likelihood of the absolute exhaustion of the supply of important resources. It recognized, however, that the prices of



many resources were likely to rise, and that shortages of key resources and the deterioration of the renewable resource base might lead to substantial environmental damage and increasing hardship for poor sections of the population. Furthermore, many biological resources were under severe and increasing stress as a result of the combined pressures of mismanagement, population growth and rising consumption levels.

The Expert Group saw no insurmountable technical barrier to the amelioration of most environmental problems. The real difficulties lay in the social and institutional sphere.

There was little consensus among the Expert Group on long-run prospects for development. However, it was their conclusion that the poor economic performance of the developed nations in the 1980s indicated that it was unlikely that the growth targets for the Third United Nations Development Decade could be met.

The experts felt constrained to re-emphasize the absolute necessity of ending military conflicts and the diversion of scarce resources to the purchase of arms. Bringing about a truly peaceful world would remove the greatest threat to mankind and the environment and would greatly enhance the resources that could be made available to assist in the task of raising levels of development throughout the world.

## II. Food and nutrition

### A. Introduction

The Expert Group was informed that total grain production in the period 1982-1983 was sufficient to provide considerably more than the 3,000 kilocalories per day required by the average adult. However, it was noted that grain production exceeded food consumption by a considerable margin because approximately 40 per cent of grain produced was devoted to the production of meat and dairy products.

Though the total agricultural production of 90 developing countries grew more rapidly than total population between 1966 and 1980, in more than half of these countries, considered individually, the rate of growth of population exceeded the rate of growth of agricultural production. And in Africa, population grew at nearly twice the rate of food production in the period between 1970 and 1980. Furthermore, the number of African countries in which population growth had outstripped agricultural growth was steadily increasing.

Even though the growth of food production exceeded the growth of population in the developing countries taken as a whole, demand, fueled by increasing per capita income (as well as population growth) had outstripped supply and this difference had been made up by imports. As a result, the developing countries as a whole were now net grain importers, whereas 50 years ago they were net exporters. And in spite of massive imports of food, an



assessment by the Food and Agriculture Organization (FAO) indicated that in the period 1974-1976 a total of 435 million persons were under-nourished, a figure that represented 23 per cent of the population of the developing countries (other than the Asian centrally planned economies).

The differences between regions were perhaps most marked in per capita protein consumption. This was two to three times the world average in the major grain-producing developed countries while it was only half that average in Africa and Asia.

Over the past two decades food consumption per person in Africa had fallen below nutritional requirements. In 1977 only 4 of the 37 African countries for which data were available had their per capita dietary energy supplies met by 100 per cent or more.

For these reasons several participants argued that the concern of the Expert Group should be focused on immediate food problems rather than on potential problems in the distant future.

#### B. Carrying capacity

Of particular importance in the relationship between food production and population is the concept of "agricultural" carrying capacity, which measures the number of persons who can be adequately fed by the agricultural output of an area. These measurements, it was noted, would be crucially dependent on the assumed nutritional requirements. Furthermore, the larger the proportion of energy requirements consumed in the form of meat, the smaller would be the carrying capacity.

The policy significance of agricultural carrying capacity was challenged by some participants. They argued that though it might be possible to meet the minimal nutritional standards of a world population which continued to grow at 1 per cent per annum, such growth would imply a world population in the order of 20 billion by the end of the twenty-first century. In such a world many would be forced to accept a very low standard of living, thus perpetuating major divisions among nations.

The Expert Group was informed about the results of the FAO work on "potential population supporting capacity of lands". By taking into account climate and soils, it was possible to determine the crop-growing potentials and yields of each land unit for the most important crops. Thus the food production potential of lands was obtained, expressed in calories and then, using standard nutrition requirements, converted into estimates of population carrying capacity.

As noted earlier, measurements of carrying capacity were crucially dependent on the choice of technology, resource conservation practices and the mix of agricultural outputs. Therefore three levels of carrying capacity were calculated. The "low" levels involved a low level of inputs, no soil conservation measures and the cultivation of the currently grown crops. The "intermediate" level assumed some modern inputs, some simple soil conservation



measures and a combination of presently grown and most calorie-productive crops. The "high" level assumed the most modern inputs, full soil conservation measures and only the most calorie-productive crops.

Carrying capacity was calculated for the regions of the developing world and separately for each nation. At the regional (and national) levels of aggregation it was assumed that there could be unrestricted movement within each region (or nation) of surplus food, production potential and/or population.

If carrying capacity was calculated under the assumption of regional self-sufficiency all regions but one appeared to have been able to meet the nutritional requirements of their populations in the year 1975 and, as projected for the year 2000, even at low input levels. (The exception was Southwest Asia). Under a regime of national self-sufficiency in food, however, the situation would become critical in many countries by the year 2000. At that time 65 developing countries could not feed their projected populations at the low level of production. Even at intermediate levels, population would exceed projected carrying capacity in 36 countries and 19 countries would be unable to feed their projected populations even under the high production regimes.

The study also showed that most of the remaining agriculturally under-utilized reserves of the world were in the high rainfall tropics where the natural vegetation was high forest. Though the view was expressed that most of these lands, if well managed, could provide attractive levels of production, many obstacles to their development would have to be overcome by intensive application of technical and managerial inputs. The view was also expressed that the FAO estimates of potential increases in agricultural production did not take into account the severe additional strain that would be placed on local ecologies and competing land uses by agricultural expansion. The conversion of large forest areas to agriculture would also entail many significant environmental costs and other costs as well.

A related calculation of the world's ultimate agricultural carrying capacity was described to the Expert Group. It was noted that, on the average, the amount of energy from the sun falling on one square metre of earth was 3,000 kilocalories per day, which was approximately equal to the nutritional energy requirements of the average adult. It was thus argued that the earth should be able to support several times present human numbers if ways were discovered to use a larger fraction of the incident sunlight. However, it was also noted that such calculations abstracted from the social constraints on the attainment of biological efficiency and thus made the agricultural support of population seem deceptively easy.

The value of global, regional or even national calculations of carrying capacity was questioned by some participants who argued that food supply was essentially a local problem and who suggested instead studies that calculated the potential for self-sufficiency at the local level. Other participants suggested that attention should be given to the study of agricultural areas with well-established eco-cultural systems.



In response to this, it was pointed out that global calculations gave one a reference point and that studies of carrying capacity could be used to deal with the entire population, resources, environment and development system. In particular, they could be used to determine whether changes could be made rapidly enough to meet the needs of other parts of the system and whether competing requirements could be met, such as water for irrigation versus water for industry. Such studies permitted nations to foresee and thus to avoid problems, and to identify inconsistencies between sectoral plans and between short-term and long-term plans.

International trade in foodstuffs should increase productivity and thereby expand carrying capacity. In this regard it was recalled that the "law of comparative" advantage stated that trade would be mutually beneficial to both regions if each specialized in the product in which it had the greatest relative efficiency.

The Expert Group also observed that for many countries food self-sufficiency was not a viable option. The importance of interregional trade was borne out by the findings of the FAO exercise. Africa presented the most striking case. Although the continent as a whole had a comfortable margin of excess productive capacity under the low input regime, in the year 2000, 30 of its 51 countries would need to import food at low input levels.

Though it was agreed that increased international trade could promote a more efficient use of world resources leading to increased productivity and growth, the Expert Group noted that shifts in the international division of labour in line with evolving comparative advantage could take place only in a stable and liberal international trade environment, and that it was doubtful whether such an environment currently prevailed.

In particular, it was pointed out that the protectionist measures of the developed countries often forced the developing countries to depart from the principles of comparative advantage. One participant suggested that though serious trade problems remained to be resolved, indefinite adherence to a policy of self-sufficiency in food would ultimately slow development and proposed that countries work towards a gradual transition from local to national to international balance in the supply and demand for food.

It was also pointed out that only a few countries accounted for the bulk of grain exports. Under such a concentrated system the importing nations face the risk of hunger if there was a crop failure in a major exporting nation, if there was a fall in the price of their own exports or if they were denied international credits. Furthermore, the importation of foodstuffs diverted limited foreign-exchange earnings from the purchase of capital goods and thus impaired programmes of industrial development.

The Expert Group also noted that the integration of the world grain market had allowed producers of meat products in developed countries to compete with direct consumers of grain in developing countries for the existing supplies. Furthermore, it was noted that if developing countries imported grains when world prices were depressed, it might discourage domestic agricultural production and foster the growth of urban populations, leaving



those countries in a position where they must continue to import foreign grains even after the world prices had risen substantially.

Given these considerations, the Expert Group understood why the Conference of Ministers of the Economic Commission for Africa had endorsed the Lagos Plan of Action of 1980 which made the goal of food self-sufficiency for Africa as a whole a major objective.

### C. Causes of undernutrition

The Expert Group noted that among the major causes for the continued prevalence of undernutrition in developing countries were : low productivity in agriculture, competing demands for agricultural production and the unequal distribution of income.

For a variety of reasons productivity in food production was very low in developing countries, particularly in Africa. Below average rainfall in the Sahel for the last 14 years, whatever the cause, had markedly affected food production in those countries. In part the poor performance in agriculture was due to the fact that farmers had not received adequate prices for their produce. On the other hand, many Governments had subsidized the import of food from abroad primarily for the benefit of urban consumers. Such policies had kept domestic food prices low and had deterred the growth in food production, often making it impossible for farmers to purchase farm inputs such as fertilizers. These practices had also led to increased rates of urbanization and had changed consumer tastes in favour of imported products, resulting in further increases in imports and consequent balance-of-payments problems.

Though the unprecedented rate of population growth since the Second World War had often been blamed for the increasing incidence of malnutrition, the Expert Group recognized that the growth in population was but one of a complex pattern of interacting factors leading to sub-optimal production and distribution of food and hence to widespread malnutrition. In order to better assess the role played by population growth, the FAO examined two alternative demographic scenarios, making use of its study, Agriculture : Towards 2000. The exercise demonstrated that a reduction in population growth would result in a roughly proportional reduction in the growth in agricultural demand. Hence lessened population growth might relieve some pressure on agricultural output.

Considering the world as a whole, the Expert Group noted that in the last two decades income gains far out-distanced population increases. While population grew by about 44 per cent, per capita incomes nearly doubled between 1960 and 1980. The result had been a significant increase in meat production with a consequent diversion of grain production from direct consumption to animal feed. Had the almost 40 per cent of total cereal production used for animal feed been made available for direct human consumption, it could have done much to eliminate malnutrition. However, the Expert Group could not be certain that this would have been the actual outcome or whether the result would simply have been a lower level of cereal production.



It was noted that the food versus feed problem was also linked with the distribution of income both among and within nations. Since about one fourth of animal feed is consumed in the developing countries, largely to provide meat products to the middle class, it was suggested (among a number of possible solutions) that an increase in meat prices might reduce consumption of the middle classes and thus make more cereals available to the poor. Others argued that this might simply lower the price of cereals and thus reduce production incentives. Some questioned whether the growth of the middle class in developing countries should be singled out as a cause of undernutrition. Others responded that in developing countries the middle class was the most rapidly growing class and devoted a considerable portion of its increased income to the purchase of meat.

Energy crops also compete with food production for land and other agricultural resources, and therefore tend to increase food prices by reducing food production. However for reasons already cited in the food or feed controversy some members of the Expert Group felt that it was not possible to determine whether the net effect of currently projected levels of energy crop production would be to reduce the available food supply.

There was general agreement among the participants that the most important reason for undernutrition was the inability of households to acquire food due to poverty. Even a high level of national agricultural output relative to population size was not considered sufficient for eliminating hunger. Rather the poverty of households, unable to produce or purchase their food, would guarantee the continuation of undernutrition. It was the conclusion of the Expert Group, therefore, that hunger was less an economic phenomenon involving production than a social phenomenon involving an unequal distribution of resources and income. For the present and the foreseeable future it was technically possible to provide an adequate diet for all. The population/food problem thus consisted of the fact that nationalism, poverty, cultural preferences in food, inefficient agriculture were problems that could not be easily resolved. Social constraints were at least as difficult to overcome as those imposed by the physical world.

#### D. Policies for improving nutrition

The state of nutrition in many countries can be improved by a combination of demographic and non-demographic policies leading to increased agricultural production and reduced competition for the existing food supply. Among the means of expanding output are augmenting agricultural inputs, improving technology, altering the output mix and improving land-tenure systems.

In some developing countries there remains considerable scope for increasing food production through the expansion of agricultural land. But there are other countries where the man/land ratio is already high and policies are required to encourage more intensive cropping.

The Expert Group was informed of the increased inputs required if world food production per person per day were to be increased from the levels that prevailed to a level 15 per cent higher in the year 2000. It was estimated



that the required increase could come about through a continued expansion of irrigation, by a tripling of fertilizer use, better control of pests, improved farming technology and genetic research leading to a doubling of the photo-synthetic efficiency. It was noted, however, that what was theoretically possible might not be ecologically desirable.

In that regard the Expert Group found that increased food production could not be achieved without the necessary improvement of rural infrastructure. Of special importance was improving the rural transportation network to facilitate the procurement of inputs and the marketing of produce. Improvement in rural housing, health services and education were also essential to the development and maintenance of adequate human resources in the agricultural sector.

The Expert Group noted that the rate at which technological innovations were disseminated to farmers could be increased by expanding and improving agricultural extension services in many countries.

Noting that countries in which labour was expensive had been the main source of new agricultural technology, with the result that there had been a bias in favour of creating labour-saving devices, the Expert Group observed that there was a need to design simple implements to enhance agricultural production, implements that were capital-, materials- and land saving. The Expert Group was also aware of the need to improve the technology for reducing post-harvest losses, which in Africa, for example, were estimated to equal as much as 30 per cent of the total grain harvest. It was also noted that the rate at which technological innovations were disseminated to farmers could be increased by expanding and improving agricultural extension services.

In this regard the Expert Group was particularly concerned with the role that population growth might play in accelerating the pace of technical change. It has often been hypothesized that an increase of population density forces the adoption of improved technology, thus making it possible for a larger population to live on the same land. However, in modern times it is not likely that population pressure can contribute to technical advance unless there is a modification of economic and political structures. Many participants argued that given the extraordinary rates of technological and social change and the huge capita investments required to meet projected food demands, a slowdown in population growth would reduce the magnitude of the challenge.

Food production could be increased if Governments would achieve a better balance between food production for domestic use and cash crops. However, the Expert Group noted that this might result in the loss of export earnings and consequently lead to balance-of-payments difficulties. Furthermore, it was observed that generally in those developing countries where food production kept pace with population growth, export-oriented agriculture grew as well.

It was also noted that the choice of particular crops should be consistent with the physical environment and that a change in dietary preferences could permit greater efficiency in feeding the populations of developing countries. In this regard it was noted that although Africa had



700 million hectares that were suitable for grain production, only about 5 per cent of this total were suitable for wheat. Therefore it was important that countries in this region promote the use of other grains, particularly maize. The Expert Group stressed the importance of nutritional education and research activities designed to increase the acceptability of locally produced foods. However it was observed that cultural preferences in food were not easily changed.

Aware that land tenure systems in many developing countries were not conducive to increased agricultural production, the Expert Group endorsed the recommendation contained in the Plan of Action of the World Conference on Agrarian Reform and Rural Development, held in Rome in 1978, that policies for reform of land tenure systems to benefit the majority of the population should be undertaken by all Governments.

The Expert Group observed that it was not yet possible to say whether the expansion of agricultural production was feasible on a world scale without dire environmental effects. (These issues are dealt with in chapter III, "Resources and the Environment".)

Though the Expert Group agreed that it was technically feasible to improve substantially per capita levels of world food production between now and 2025, it observed that a large part of that increase would have to take place in the currently developed countries. Thus, in order to equalize consumption levels in the two groups of countries, the developing countries would need to import vast quantities of grain from the developed countries.

These imports could be paid for by increased exports or increased borrowing from abroad. Both approaches involved significant costs, and reduced the capital available for productive investment and economic growth. Nations might pay for increased imports of food by increased exports of cash crops, other commodities or industrial output. Though the Lima targets called for an expansion of industrial exports from developing to developed countries, it was observed that a long time must elapse before the former group of countries could compete effectively.

With regard to increased borrowing from abroad, the Expert Group noted that the purchase of food on credit had already contributed substantially to the third world's heavy indebtedness.

In the short run, grain purchased at concessionary prices or favourable credit terms could help meet the nutritional requirements of a rapidly growing population. However, in the long run these imports would tend to promote the growth of large urban populations who would be dependent on the continued inflow of low-cost foreign grain. These urban populations would find themselves defenseless against crop fluctuations in the major exporting countries, or in the face of high international interest rates.

In addition to increasing agricultural production and, if necessary, increasing grain imports, nations could reduce the number of people who were undernourished by reducing competing demands. Given the importance of population growth as a factor in determining total food consumption, policies



to slow the rate of population growth would contribute to increasing the availability of food and lowering its price to the poor. Slowing the rate of rural to urban migration might also reduce the demand for imported convenience foods. Most important of all was the adoption of policies to promote a more equal distribution of income so that all would be able to produce or purchase enough food for proper nutrition.

Even though average rates of production might be sufficient to meet nutritional requirements, it was necessary to have reserves that acted as a buffer to convert fluctuating rates of production into a continuous supply to households. Though each country could have its own immediately accessible reserve, it was noted that if each separate country were to be self-sufficient in the face of all contingencies, the cost would be formidable. Since the world grain crop showed less fluctuation from year to year than did the grain production of individual nations, the need for maintaining national reserves could largely be obviated through maintaining appropriate regional and global reserves and by ensuring that the channels of international trade were kept open so that surpluses could flow to countries in deficit.

### III. Resources and environment

In discussing food and nutrition the participants dealt primarily with the demographic, economic and social aspects of food production. In their deliberations on resources and the environment the physical dimension was emphasized. Still, many demographic and socio-economic variables also have an important bearing on resources and environment and they were therefore often mentioned.

It was reiterated that the distinction between resources and the environment was largely artificial. Although much of the discussion focused on the land-resource base, particularly as it related to food production, other resources, notably forests, water, climate, non-fuel minerals and energy resources, also received careful attention.

In general, this chapter describes resource and environmental constraints which must be added to the already discussed social, economic, political and institutional constraints in order to identify a feasible set of solutions to the food and nutrition problem. Finally, this chapter addresses the relationship of population to resources and the environment. Population can be viewed both as an agent in resource use and environmental change and as being affected by such use and change.

#### A. Resource base

During the period between 1860 and 1980 the area of the world's farmland more than doubled, while during this same period the world population increased by about three and one half times. On a world-wide basis, and to a large extent within regions, the decrease in farm area per person over time reflects the increase in productivity per hectare.



It was pointed out that the real food reserve potential lay not so much in idle land, but in raising technology levels. Thus, although many countries might find it difficult to increase their land-resource base, the combination of increasing yields and cropping intensity still provided a considerable margin of safety.

It was observed that many African and Latin American countries still had relatively ample land resources and had at present favourable man/land ratios. Hence in Latin America growth in agricultural production had been and continued to be based chiefly on an increase in area harvested. Although productivity was making increasing contributions to the total produced, 60 per cent of the expansion of agricultural production during the 1970s was accounted for by harvesting of more area.

The situation was less sanguine in Asia where most if not all the potential arable land outside the humid tropics was already cultivated. Consequently, it was agreed that there was an urgent need to raise the productivity of land in Asia, through agricultural research and investments in irrigation.

Although the discussion on land availability and expansion led to some relatively optimistic observations, a more pessimistic tone emerged when the environmental dimension was added to the deliberations. Thus, while carrying capacity of land could be increased, the Expert Group recognized that this might also increase the risks of erosion, desertification, shortening of fallow periods and use of organic matter as fuel instead of as fertilizer. It was observed that in many developing countries land maintenance left much to be desired and that meeting the requirements of increasing populations had, in fact, contributed to the degradation of the land-resource base.

In many parts of the world and especially in the grasslands of Central Asia, Africa, Oceania and Latin America, human and livestock populations had a tendency to grow together. Further increases in human and livestock populations would lead to denuding and subsequent erosion of soils.

Some participants pointed out that the apparent availability of large unused land areas in Africa and Latin America was misleading. For example, in Africa, useful agricultural land had been severely degraded at a rate of 60,000 to 70,000 square kilometres per year, affecting the livelihood of about 60 million people directly. Furthermore, each year some 25,000 square kilometres of African land was being lost because of soil erosion. Also in Africa, there were large areas whose climate, soils or other ecological factors made farming or even sustained grazing impossible. In marginal areas soil conditions and meagre rainfall necessitated lengthy fallow periods because technologies for more intensive agriculture were often not available. More intensive use for agriculture and grazing might accelerate permanent loss of arable land. In the case of Latin America, at least 66 per cent of projected land expansion would take place in areas where the ecological risks would be high.

Though increasing numbers of small farmers could cause considerable damage in their attempts to obtain more land, the environmental consequences



of activities of large agribusinesses, such as the use of inappropriate technologies, might be even more serious. Capital-intensive agricultural development could make food production grow faster than population, but could also intensify the concentration of land, capital and production thereby contributing to landlessness. In turn the increase in the number of landless people contributed to many other social and ecological problems including excessive rates of urbanization, extensive underemployment of labour and the destruction of soils, forests and wildlife.

Despite very rapid migration to cities, the Expert Group noted that rural populations were still growing at close to 2 per cent a year in much of Africa and Asia, and that land settlement or colonization schemes could not absorb more than a small fraction of potential farmers. The result had been increasing landlessness. According to the Food and Agriculture Organization (FAO), some 30 per cent of the rural labour force was landless in the market economies of Asia. It was observed that landless labourers, together with sharecroppers and marginal farmers, constituted the majority of rural residents in most countries of Asia and Latin America and that their number was increasing rapidly in Africa.

While food production potentials might appear large, many calculations of potential output did not reflect the impact of reducing forest areas, take full account of alternate demands on the water supplies required for irrigation, or consider the effects of increased carbon dioxide. Often they also depended on untested assumptions concerning the availability of raw materials.

The spread of agriculture outside traditional farming zones was considered the largest single cause of deforestation in the developing countries today. The Expert Group noted that where lands were suitable and proper technologies were available, forest clearance for farming could be desirable, so long as it was accompanied by watershed protection, the preservation of natural areas and the enforcement of sustainable land uses. But much of today's deforestation was on lands that were ill-suited for agriculture. The spread of peasant farming, excessive fuelwood collection, shifting cultivation, commercial farming (such as the creation of grasslands to produce beef for export) and unregulated logging were the principal causes of rain forest clearance.

Furthermore, it was pointed out that if current trends in deforestation continued, thousands and possibly millions of plant and animal species would become extinct over the next two decades. The loss of potential industrial and agricultural products, of new medicinal substances and of genetic materials could be substantial.

Deforestation in hilly and mountainous regions was considered of particular concern. Often the topsoil washed away within a few years, destroying the productive potential of the hills and causing serious problems downstream such as silting of reservoirs, canals and harbours. It was also observed that deforestation contributed to an increased concentration of carbon dioxide in the atmosphere, especially as carbon is released from old-growth forests through this land-use conversion.



The Expert Group noted that though the supply of fresh water at the global level appeared to be more than adequate, there might well be regional water shortages, especially in densely populated regions. In addition to expressing concern for the availability of safe drinking water, the participants noted that inexpensive and reliable sources of water were essential for irrigation and that increasing competition for water by urban and industrial uses put severe strains on the supplies available for agricultural use.

The Expert Group observed that though additional irrigation would be essential to raise rice production in Asia, the constraining factors would not be the amount of water available in Asian rivers but the capital costs to expand the irrigated area and to improve the present irrigation systems. In this regard the proposed Indian National Water Grid, which would cover the entire Indian Peninsula and link all its major rivers, was noted. And it was observed that the concept of national (or international) water grids might be worthy of study and application in other countries and regions.

Some participants stressed the impact of environmental problems such as overgrazing and deforestation on the supply of water. For example, the loss of vegetative cover by overgrazing in the Sahel had affected the characteristics of the ground surface in regard to the absorption of solar radiation, causing more reflection of sunlight from the surface and thereby decreasing rainfall. Hillside deforestation, on the other hand, especially of smaller watersheds, would lead to disruptions of the hydrological cycle, resulting in increased flooding in rainy periods and the desiccation of springs and streams in dry periods.

Besides the problems associated with providing an adequate supply of water, the Expert Group was also concerned with water quality. It was observed that, with regard to oceans, most pollution occurred in estuaries and coastal waters. The pollution was primarily caused by sewage disposal, agricultural chemicals, oil spills and metals. Inland water bodies also suffered from various forms of pollution, mostly caused by discharges from industries and drainage from agricultural chemicals. The latter was considered a particular source of concern. Agricultural chemicals contained in fertilizers and pesticides posed hazards to aquatic life and human health since they caused the pollution of ground and surface waters.

It was pointed out that climate could be regarded as a common property resource which belonged to all nations, and that national actions might adversely affect the climate in other countries. The Expert Group observed that industrialization and its concomitant energy use had led to substantial increases in emission of sulphur and nitrogen oxides. Long distance transport of these oxides had resulted in acid rain which had adversely affected the aquatic life of inland waters.

Growth in population usually resulted in increased energy use which could affect the climate globally, regionally and locally. In particular, the increase of carbon dioxide by burning fossil fuels might have large effects on global climate. It was asserted that the carbon dioxide concentration in the atmosphere would double some time during the next century which in turn would



probably increase the average global temperature by 1 to 4 degrees Celsius and thus alter the distribution of global rainfall. Though there was a consensus on likely trends in levels of atmospheric carbon dioxide, the Expert Group was of the opinion that not enough was now known to be certain about the likely effects of these trends. While most effects of increased concentration of carbon dioxide in the atmosphere were negative, it was also observed that higher concentrations of carbon dioxide in the atmosphere would serve as natural fertilizer through photosynthesis.

The Expert Group also noted that depletion of stratospheric ozone was taking place as a result of increased releases of chlorofluorocarbons. The main effect of ozone depletion was an increase in ultraviolet radiation reaching the earth's surface. This increase of ultraviolet radiation could kill micro-organisms and destroy cells, plants and animals, with consequent detrimental effects on different ecosystems, and it might cause undesirable global climatic changes.

It was agreed that the supply of mineral resources needed for accelerated development did not pose a problem of absolute scarcity, but one of exploiting increasingly inaccessible sources. The exploration of the sea-bed was cited as a case in point. Therefore, the concern about mineral resources largely related to the impact of rising costs.

The Expert Group noted the difference between natural resource reserves and total resources. The former were known and, under present economic and technological conditions, recoverable resources. The latter, however, included both reserves and deposits which under present economic and/or technological conditions were not recoverable, as well as deposits that were presumed to exist but that had not yet been discovered.

Changes in technology and economic conditions brought about shifts between reserves and resources. Previously inaccessible or low-grade deposits might through new techniques or increased demand become worthwhile for exploitation. Similarly, previously exploitable deposits of minerals might, due to changed economic conditions, become no longer worth exploiting and would thus be regarded as resources rather than reserves. Normally estimates of reserves and resources tended to be revised upward over time.

For the period 2000 to 2025 there would be a need to rely on resources rather than reserves and this reliance might have serious implications for investment, technological progress, conservation and recycling. It was pointed out that in all of these areas international co-operation, such as had been achieved in the Law of the Sea Treaty, would be essential to achieve an efficient, equitable and rational exploitation of resources.

The United Nations Industrial Development Organization (UNIDO) found that crude petroleum and natural gas reserves were sufficient to the year 2000 but not much beyond that time, but that coal reserves would not be exhausted until about 2050. Thus, the initial indications were that these conventional energy sources would not be exhausted by 2000, even at the high growth rates necessary to reach the targets of the International Development Strategy for the Third United Nations Development Decade. But major organizational and



technological changes would be required to facilitate the transformation from oil to other fuels. If presently estimated resources could be used, then they would be more than sufficient to sustain further growth of the world economy to 2025 and beyond.

Although conventional energy resources appeared to give no reason for concern at the global level until well into the twenty-first century, there was reason for concern about regional balances. For example, Latin America had abundant resources of hydrocarbons, hydroelectricity and coal, but they were distributed very unevenly. Consequently, new patterns of international trade, finance and co-operation would be needed in order to achieve an efficient exploitation of existing energy reserves.

Despite these relatively optimistic findings, it was observed that the developing countries with more than three fourths of the world population accounted for only 14 per cent of the total petroleum consumption. It was reasonable to expect therefore that petroleum consumption would increase rapidly in these areas. Furthermore, 25 per cent of the energy consumption of these countries was being met from renewable sources of energy, particularly fuelwood for which growing shortages were to be expected. This might further constrain development efforts, especially in Asia.

Furthermore, it was noted that increased dependence on renewable sources of energy might increase the pressure on the supply of arable land available for food production.

#### B. Role of population

Though the Expert Group agreed that population through its size and growth affected resource use and environmental change and that, conversely, population size and growth were affected by the availability of resources and the quality of the environment, it was felt that the role of population varied from country to country depending on the level of development, resource availability and level of technology applied.

Although it should be possible in every country to satisfy the nutritional needs of a much larger population, satisfaction of higher-level needs was likely to prove more difficult. As population increased, many developmental options might be lost. One broad class of options concerned the preservation of desirable characteristics of the natural environment. The accommodation of large populations at high income levels often entailed a steady disappearance of many important environmental amenities.

Though it was argued that increased population in a given territory might mean reduced per capita availability of natural resources, others held that the date of attaining the ultimate population size was far enough in the future to permit most current technological constraints to be overcome, and perhaps also to permit a change in the structure of international trade, so that densely populated countries could greatly reduce their current dependence on land or other natural resources through an emphasis on industrial production.



Internal migration was seen by some as an adjustment to resource imbalances. Noting that urbanization could play an important role in responding to rural resource shortage, some participants argued that there was no necessary relationship between the degree of urban concentration and the degree of environmental deterioration and that the distribution of the costs and benefits derived from environmental change depended more on the general style of development than on the size of urban areas or the rate of their growth. It was also argued that rural to rural migration to new frontier areas could also perform a number of important functions, enabling rural populations to escape from unemployment and land scarcities in their areas of origin, while avoiding long periods of unemployment in urban areas.

The existing distribution of the world's population between countries, it was observed, was poorly related to relative resource endowments. Though it would result in a higher total world product, the Expert Group recognized that bringing about a better balance between population and resources by means of international migration could prove exceedingly difficult in the present world context.

#### IV. Economic and social aspects of development

##### A. Introduction

The deliberations of the Expert Group demonstrated that in developing countries poverty was the underlying cause of many, if not most, of the problems arising out of the interrelations between population, resources and environment and development. Conversely, the misuse of affluence was a cause of many of the environmental and resource problems of developed countries and also had adverse impacts in a number of developing countries. Thus the discussion of socio-economic development was focused on factors critical to the lessening of differentials in levels of living between and within countries. The topics included income distribution, employment, health, education and old-age security.

##### B. Income distribution

The Expert Group was mindful that the terms equality and equity were not synonymous and observed that particular attention should be given to eliminating those inequalities deemed to be particularly unfair or inequitable.

The Expert Group noted that inequality in income, assets and access to public services had significant effects on population as well as resources and the environment. A substantial body of research had indicated that reducing differentials tended to lower fertility levels, as well as mortality levels. It was recognized, however, that the relationship between fertility and mortality levels on the one hand, and the extent and nature of inequality, on the other, was neither simple nor direct.



It was suggested that such correlations as existed between fertility decline and greater equality might be explained by the fact that the changes needed to alter substantially the distribution of income also had a significant impact on fertility trends. In that regard, it was also observed that greater equality in access to public services such as health and education (especially on the part of women) might have a greater impact on fertility than a lessening of inequality in the distribution of income.

Rural-urban differentials were recognized as important factors in promoting migration to the cities and similarly differences in levels of living between nations were important causes of international migration.

The Expert Group noted that inequalities could take a variety of forms including unequal individual or household incomes, unequal holdings of land or other assets, unequal access to employment, health services and education and unequal mortality experience. Similarly, the problem of inequality could be examined at many levels: between individuals, households, communities, nations and both sub-national and international regions. In studying the linkages between demographic factors and inequalities, it was important to remember that the strength and even the direction of the relationship would depend on the form and level of inequality.

It was observed that both population growth and patterns of development contributed to perpetuating the inequalities among nations. Differential demographic growth contributed significantly to maintaining and even widening the prevailing differentials between rich and poor countries. It was observed that high rates of population growth had greatly reduced, and in many instances more than eliminated, the relative gains that developing countries could otherwise have realized from their generally high rates of growth in GDP during the last 20 years.

There are a variety of reasons to expect rapid population growth to contribute to increased inequalities within nations as well. Population growth increases the supply of labourers relative to land and capital and thus reduces wage rates. It leads to the division of land into holdings that are too small to be viable, which in turn leads to a concentration of land ownership as well as increased landlessness. Since population growth is most rapid among lower income groups, relative incomes of the poor would fall if their aggregate share of total income were fixed. Similarly, if government budgets for education and other services to the poor are relatively fixed, then rapid population growth will dilute the quality of those services or reduce the fraction of the poor population that they can reach. Finally, high fertility may limit the capacity of parents to invest in the health and education of their children.

The Expert Group was aware that these processes took place over a considerable period of time and therefore were best studied on the basis of historical time series. Because these were rarely available, the relationships were often estimated from international cross-section data. The findings of one such study was described to the Expert Group. Contrary to expectations, no strong relationship between inequality and population growth was found.



A number of participants argued that the failure to find a strong correlation between income distribution and population growth did not rule out the possibility that strong causal relationships between the two might exist. The linkages might have been obscured by problems of data quality. Furthermore, the distribution of income was determined by (a) the distribution of resources; (b) the amounts of these resources used productively and (c) the rates of remuneration per unit. Each of these three factors might react differently to changes in the rate of population growth. Furthermore, a given rate of population growth might represent the difference between a low fertility rate and a low mortality rate or a high fertility and a high mortality rate. The relationship to inequality might be different in the two cases.

There was general agreement that insofar as population growth was an important cause of widespread poverty it operated through a variety of intermediate variables, which could include unemployment and underemployment of labour, patterns of resource ownership, consumption patterns and international trade and financial relationships.

### C. Employment

It was reiterated that providing employment was a vitally important social goal, since it gave the employed person marketable skills, status and a sense of participation in the larger society. But combatting unemployment and underemployment was also essential for the elimination of poverty. Therefore the task facing Governments was to generate a sufficient number of adequately remunerative jobs. Given the already high levels of unemployment and underemployment and the expected increases in the labour force, this task was a most formidable one.

The Expert Group was particularly concerned by the high levels of unemployment and underemployment that now prevailed in both developed and developing countries. The view was therefore expressed that finding productive employment for the large cohorts of young people who were now or would soon be joining the labour force would be the key problem of the next decade.

Due, in part, to the increased labour force participation of women, the labour force had grown rapidly in the developed countries. That labour force growth, combined with a prolonged recession, had resulted in increasing levels of unemployment. However, the rate of growth of the labour force in developed countries was now declining and would continue to decline.

It was argued by some that rapid population growth contributed directly to increasing unemployment by increasing the number of new entrants into the labour force and indirectly by reducing the ability of families to save, and thereby impeding capital formation which, it was averred, was necessary for increased employment. Both explanations of the role of population in employment were challenged. Some participants expressed the view that the underlying cause of unemployment was not the growth of the labour force but incorrect public policies. In most developing countries, for example,



employment possibilities depended crucially on adopting the proper agricultural policies. Others argued that there was little empirical support for claims that rapid population growth inhibited savings or that capital formation was necessary for creating employment. The Expert Group therefore concluded that population growth policy might not be able to exert a significant influence on the employment problem during the next two decades, especially since most of the expected entrants to the labour force had already been born. Over a longer period, however, a slowing of the rate of population growth would reduce the number of jobs that must be created and thus should reduce levels of unemployment.

The Expert Group was informed of an exercise by the United Nations Industrial Development Organization (UNIDO) which demonstrated that if the targets envisioned in the International Strategy for the Third United Nations Development Decade were met, the high rates of economic growth would make it possible to fully employ the available labour force by the year 2000 and 25 years later labour would be in short supply. However, some participants argued that the economic growth rates assumed in the exercise could not be reached and therefore questioned the viability of a strategy that emphasized increases in industrial employment.

The experts did not reach full agreement on the net effect of investment on employment. Some argued that capital accumulation was necessary to increase employment while others pointed out that new investment was often accompanied by the introduction of a new technology which might expand employment in some sectors but reduce employment in others.

Some participants suggested that many opportunities existed for expanding employment in the agricultural sectors of developing countries by encouraging the consumption of locally produced foods, and the creation of adequate infrastructure. Furthermore, the provision of infrastructure (such as the expansion of the transport network and irrigation) would itself generate significant rural employment opportunities. The Expert Group was also reminded of opportunities in the service sector. The need for additional teachers was cited as a case in point.

Other members of the Expert Group were less sanguine about the possibility of creating truly productive employment in the agricultural and service sectors. It was argued that expanding the number of such jobs would simply promote inefficiency and waste human resources in tasks best described as "drudgery". The opposing view was that in many situations in developing countries, the most practical way to equalize incomes was by spreading the work evenly so that all might earn at least a modicum of income.

The Expert Group was aware of the great significance of technical change for employment. Like capital formation, technical change created new jobs in some sectors even as it destroyed them in others. Some participants advanced the view that we were in the midst of an entirely new wave of technical innovation which would finally liberate humans from routine or "brute" physical work. However, the absorption of these technologies would require a long and difficult period of social and economic transformation. In the developing countries the transitional period would be particularly traumatic.



Even though labour was plentiful, these countries were also introducing the new labour-saving technologies. This process was being accelerated in part because of the technological influence of multinational corporations and in part because developed countries had accumulated large international debts and must produce products that could compete in price and quality in international markets. The notion of comparative advantage based on cheap labour had become obsolete with the introduction of these new technologies.

The Expert Group agreed that the spread of these advanced technologies to the developing countries was an irreversible process and therefore suggested that Governments should devise strategies to cope with the socio-economic effects of the new wave of innovations.

In the meantime the Expert Group noted that the capacity for carrying out research and technological development was largely concentrated in the developed countries. Consequently, the Expert Group observed that there was a need to create in developing countries the human resources and institutions necessary to carry out research and development in order to select and adapt the new technologies to the specific needs of those countries. In that regard it was observed that technical innovations that used capital produced by local labour and that used locally produced materials would be particularly effective in creating employment and accelerating development.

#### D. Health and education

The Expert Group was concerned with the health and education sectors for a variety of reasons. It was recognized that they were major components of a national effort to expand its resource base through investment in human capital. The type and amount of education, as well as the state of health of the labour force, would strongly influence the supply of employment opportunities. The public provision of health and education could do much to reduce inequalities in well-being and they would greatly influence the components of demographic change.

It was noted that in developing countries demographic factors had an overwhelming impact on the ability of the educational and health services to meet the requirements of the population. In particular, many of the costs of programmes in these areas varied directly with population size.

The Expert Group recognized that the state of education of the people would in large part determine its ability to ensure cultural continuity while adapting to technical change. In particular, the educational system could play a critical role in the formulation of attitudes and the adoption of behaviour patterns which would correspond to particular styles of development.

Unfortunately, education had often had the effect of making young people in developing countries dissatisfied with rural life, leading them to migrate to the cities. Though beneficial from the individual point of view, these migratory flows often stripped the agricultural sector of able-bodied young people while intensifying the employment problem in urban areas.



The Expert Group was aware that improvement in health systems could have profound impacts on the age structure as well as on the size of populations. In developing countries, improvements in the health system were likely to have their greatest impact on infant mortality, while in the developed countries, improvements in health systems were more likely to be aimed at prolonging and improving the quality of life of the elderly.

Though the linkage between health and access to pure water and sanitation were well known, the Expert Group was concerned that far too little information was available about the health implications of other aspects of the human environment. In particular the effects of new chemical compounds in our food and elsewhere in the environment were not yet well known.

It was noted that though all demographic factors were important in determining requirements for health services, it was population growth that was severely taxing the health-care systems of developing countries, while in the developed countries much of the increased demand for medical services was associated with the aging of their populations and particularly with the rapidly increasing numbers of persons who were beyond the age of retirement. Since the costs of providing health-care to this group were largely borne by publicly financed social security systems, the Expert Group observed that in years to come, this was likely to cause increasingly serious problems of intergenerational transfers of income. Furthermore, the cost problem had been aggravated by the increasing use of extremely expensive procedures and equipment.

Some members of the Expert Group observed that national family planning programmes could make a significant contribution to improving the state of health in developing countries. Providing information and services to women should significantly reduce health problems caused by inadequate spacing of births, pregnancies at very early or advanced ages and complications arising from illegal abortion.

It was noted that more than half the population of the developing countries lacked access to pure water and that conditions were even worse with regard to sanitary facilities, and that this contributed to high levels of mortality and morbidity. However, it was recognized that investment in water and sanitary facilities would divert significant amounts of capital from other development projects and that by slowing rates of population growth, the amounts of capital that would have to be diverted could be lessened.

#### E. Social security for the aging

It was recognized that systems of social security, particularly in developed countries, could have wide scope, dealing with problems of unemployment, medical care, disability insurance, support of orphans, widows as well as the aged. Thus a variety of issues relating to social security systems were discussed by the Expert Group, but primary attention was given to the problem of meeting the needs of growing elderly populations. Of greatest concern was meeting the needs of the elderly for incomes and medical care.



The Expert Group noted that as a result of overall population growth in combination with declining fertility, the absolute relative size of the aging populations in all regions would continue to increase. But relative to the size of the working age population, the developed countries would face the heaviest burdens in providing a decent standard of living for the elderly in years to come.

It was noted that the trend towards an increasing average age in the developing countries might have beneficial effects in that a greater proportion of the population would be of working age. To some extent, however, this might be offset by larger numbers of young persons remaining out of the labour force in order to complete their educations. Furthermore, growth in the labour force intensified the problems of the developing countries in providing sufficient remunerative employment. In addition, though the overall dependency burden of the developing countries would be reduced, there would be an increasing share of the elderly among the dependent population.

It was recognized by the Expert Group that the need for security in old age was an important factor in the desire for large family size. Therefore, developing countries desiring to reduce fertility levels must develop institutions that would assure support in their later years to couples who chose a small family size.

As family size declined in the developing countries, it would be increasingly difficult to assure adequate care for all of the elderly. Since many developing countries currently lacked the organizational and administrative resources to implement social security schemes effectively, particularly in their rural areas, the Expert Group agreed that it would generally be inappropriate to attempt to meet the needs of the elderly in those countries through social security programmes patterned after those of the industrialized countries. Rather it was recommended that particular efforts should be made to develop community institutions to supplement the care given by families and Governments.

In the developed countries, income and health care for the elderly were increasingly provided through social security systems. A difficult transfer problem arose in the case of the elderly in developed countries who were likely to live in separate households, receiving limited support from their children. Taxes must therefore be collected from the working population and redistributed to the elderly. As the tax burden became heavier, there might be increased resistance to further tax increases even though they might be required to maintain the solvency of the system.

It was noted that in developed countries social security systems had been impaired by the economic crisis, the extension of benefits and coverage and the continuing aging of the population.

Of special concern to the developed countries was the significant rise in the proportion of the population who were very old (75 years and over). This group often faced disproportionately high medical costs and often could count on only limited support from their children who were themselves likely to be elderly.



Some argued that the minimum age of retirement should not be fixed but should move upward gradually in proportion to increases in life expectancy. Others were concerned lest an increase in the age of retirement should limit opportunities for advancement of younger workers and make them even more vulnerable to the effects of unemployment.

#### V. Integration in policy, planning and programmes

There have been significant changes in the planning process in recent decades. In the 1950s virtually all attention was focussed on economic planning. In the 1960s social planning was added and in the 1970s population factors were introduced into the planning exercise. In the 1980s, resources and the environment are becoming increasingly important dimensions of the overall planning process. Though some promising attempts were being made based on the assessment of carrying capacity, the Expert Group observed that integrated planning was still in an experimental stage and that there was no guarantee of its success.

The term "carrying capacity" has been described as the level of population size which can for the foreseeable future be supported by a country at a given physical standard of living. Defined in this way the carrying capacity of a region may be increased in a variety of ways: through changes in cultural values, technological discoveries, improved agricultural practices and land-tenure systems, improvements in education systems, the modification of fiscal and legal arrangements, discoveries of new mineral sources or the emergence of a new political will. Furthermore, the carrying capacity of an area is not only directly related to an area's capacity for food production, but also to its capacity to integrate itself into a system of international trade. In short it is the decisive measure of the population size that can be supported at a given level of welfare. Thus measures of carrying capacity will be crucially dependent on the assumed level of aggregation.

This broad concept of carrying capacity differs from the notion of agricultural carrying capacity in that it deals with more than man's nutritional requirements and therefore is perhaps more relevant for policy. However, an extremely difficult problem facing those who would quantify carrying capacity in this broader sense is finding a single unit in which to express aggregate outputs and requirements. The Expert Group noted with interest that the United Nations Educational, Scientific and Cultural Organization (UNESCO) was developing an approach which used energy units as the common denominator and that plans were being made to link the work of UNESCO with the FAO study on the carrying capacity of lands in the context of national situations.

It was recognized that the formulation of a fully integrated plan that would include population, resource and environmental concerns must resolve a number of difficult problems. Often demographic studies had not been useful for development planning purposes, in part because demographers were not familiar with the requirements of development planning, in part because of the limited knowledge base relating to complex population-development



interrelationships. On the other hand, some planners had a simplistic view of population problems, focusing largely on population size and growth. Furthermore, planners were too often concerned only with promoting the economic aspects of development. In addition, planning approaches and structures were overly rigid, while vertical ministerial structures were ill-suited to deal with problems such as unemployment and environmental degradation which cut across sectoral boundaries.

Because the search for specific developmental activities that could be expected to influence population growth rates had yet to produce a sufficient number of implementable policies, population variables were generally treated as exogenous planning components. Thus, population policies and targets were often set independently of social and economic policies, and of the major socio-economic aspects of development plans. Therefore, there was a need for a broader approach to the adoption of both population and development policies.

The Expert Group recognized the efforts made to identify the influence of changes in the size and structure of population on the major development sectors, especially in health and education. However, it was felt that demographic factors had not been sufficiently incorporated into overall development planning in a broad multidisciplinary context. Conversely, it was pointed out that the effects of sectoral development on population change had often been neglected. For example, the impact of developments in health, education and food supply on mortality reduction, and of urban housing and social welfare programmes on rural-urban migration were still inadequately considered.

Other participants stressed the fact that the interrelationships between population, resources, environment and development differed in form and intensity between sectors and countries, and even between areas within most countries. Many of these differences depended on the level of development and on social and cultural considerations.

The findings on interrelationships underline the importance of an integrated multidisciplinary perspective in the formulation of long-term objectives. It was pointed out that the knowledge and understanding of the interrelationships between population, resources, environment and development were prerequisites for integrated planning and policy-making. In this context, population policies would have a critical role to play. Therefore, policy-makers and institutions must adopt a more integrated and systemic approach.

Three demographic factors were identified as possible areas of intervention to reduce rapid rates of national population growth: international migration, mortality and fertility. Of these three only fertility was found to be significantly amenable to policy intervention. It was observed that national policies relating to international migration were not likely to make a significant contribution to the solution of problems caused by rapid population growth. Since mortality levels in developing countries were still very high, further improvement were still possible. Though this might initially increase rates of population growth, it had often been postulated that lowering infant and child mortality would ultimately



contribute to reduced fertility. In any event, the goal of reducing mortality had generally been pursued without regard to its possible impact on population growth. Consequently, policies affecting fertility were the only remaining option for reducing rates of population growth; insofar as such growth was considered undesirable.

In considering ways in which fertility might be reduced, it was suggested that the dichotomy between family planning and general socio-economic development was no longer valid since family planning had been incorporated as an element of development.

The Expert Group noted that population size could change only slowly and that the young age structures of the developing countries would result in great demographic inertia. Because population policy would require such a long time to have an appreciable effect on population size, many members of the group felt that there was a need for planning exercises based on a long-time horizon between 20 or 30 years.

## VI. Recommendations

The Expert Group reiterated the full validity of the principles and objectives of the World Population Plan of Action. Among those particularly relevant to its work were: (a) "The principle aim of social, economic and cultural development, of which population goals and policies are integral parts is to improve levels of living and the quality of life of the people"; (b) "Population policies are constituent elements of socio-economic development policies, never substitutes for them"; and (c) "In the democratic formulation of national population goals and policies, consideration must be given, together with other economic factors, to the supplies and characteristics of natural resources and to the quality of the environment".

Following intensive discussions of current and projected trends in population, resources and the environment and their interrelated impact in a number of areas, such as food and nutrition, the Expert Group recommended a variety of actions that, in its view, would lead towards the achievement of objectives specified in the World Population Plan of Action. In accordance with the instructions of the participants, the recommendations contained herein were drafted by the United Nations Secretariat on the basis of the discussion and documentation, submitted in writing to the participants for comment and prepared in final form by the Rapporteur of the Meeting.

The sub-headings used in the following recommendations are not intended to suggest any order of priority.

### Food and nutrition

1. In view of the necessity to expand agricultural production substantially to meet the food requirements of the projected populations of developing countries in the year 2000 and beyond, the Expert Group recommends:



- (a) That substantial investments should be made in rural infrastructure including transportation, marketing facilities, education and health;
- (b) That, where appropriate, land under cultivation should be expanded;
- (c) That substantial investments should be made now for the planning and design of future irrigation facilities, giving particular attention to minimizing negative environmental effects;
- (d) That policies should be implemented for reform of land-tenure systems as called for in the Plan of Action of the World Conference on Agrarian Reform and Rural Development;
- (e) That agricultural extension services should be strengthened;
- (f) That the appropriate use should be made of modern agricultural technologies including high-yield varieties, fertilizers, herbicides and pesticides, in ways designed to minimize negative environmental effects.

2. Governments, particularly in developing countries, are urged to promote, through education, better nutritional methods among their populations, giving special attention to rural areas and to the use of locally available foods.

3. Care should be taken to achieve an appropriate balance between the goals of food self-sufficiency and the growing of those crops for which a country is best adapted.

4. An international food trade regime should be established which would guarantee an effective sharing of world food supplies in times of emergency. The Expert Group also recognizes that it would be prudent to make provision at the national and regional levels for unpredictable declines in food supplies.

#### Resources and the environment

5. Governments should adopt and fully implement the provisions of the FAO World Soil Charter.

6. Since most of the remaining agriculturally underutilized land reserves are in the high rainfall tropics, and the proper development of these lands would require the intensive application of both technical and managerial inputs, the Expert Group recommends that the Governments concerned should create the economically and socially effective institutions required to support sustainable agricultural activity.

7. In order to reduce erosion and meet future needs for timber and firewood, the process of deforestation should be controlled and in certain areas stopped altogether. It is recommended that the Governments concerned should either



initiate or expand well designed large-scale reafforestation programmes and that where possible the growth of trees should be integrated into regular farming practices.

8. The Expert Group recommends that water development plans should reflect carefully the needs of increasing populations, particularly with regard to food.

9. In view of the importance of maintaining and protecting the resource base and the quality of the environment, while at the same time meeting the demands of present and future populations, the Expert Group recommends:

- (a) That environmental impact statements should be established on large-scale development projects;
- (b) That there should be proper management and disposal of hazardous industrial and agricultural wastes which have deleterious health and environmental effects;
- (c) That irreversible changes in resource productivity should be prevented, particularly with regard to renewable resources;
- (d) That pollution control mechanisms should be established in order to minimize the negative environmental effects of water and air pollution and to maximize the quality of air and water;
- (e) That genetic diversity should be protected in order to prevent the loss of potentially valuable genetic material.

#### Economic and social development

10. Governments are invited to give consideration to modifying their conventions with regard to the rights of ownership and the inheritance of property in such a way as to promote greater equality.

11. The Expert Group recommends that Governments should redress the imbalance between rural and urban levels of living by giving increased attention to the infrastructure needs of less developed regions and rural areas.

12. The Expert Group recommends that Governments should give consideration to lowering their barriers to the international flow of exports and of workers and their families.

13. To the greatest extent possible, investments in new industries in developing countries should be geographically decentralized.

14. The Expert Group recommends that host Governments should adopt explicit policies to regulate and control activities of transnational corporations.

15. Governments should give increased attention to providing health facilities and services to rural areas in accordance with the objectives endorsed by the Alma Ata Conference on Primary Health Care.



16. Governments should include family planning as a component of health planning.

17. The Expert Group recommends that high priority should be given to meeting the goals established for the International Drinking Water Supply and Sanitation Decade.

18. The Expert Group recommends that education systems should be reoriented to better meet developmental needs by better preparing students, so that the distribution of skills and knowledge in the labour force will be congruent with the prospective economic structure of the country.

19. In view of the central role of women in social and economic development, special emphasis should be given to assuring that females shall receive equality of educational opportunity.

20. The Expert Group recommends that in developing countries, particular efforts should be made to create community institutions which would supplement care given to the aged by their families and by Governments, in order to meet the need for security in old age.

#### Integration in policy, planning and programmes

21. In countries where there are imbalances between trends in population growth and present and projected resource and environmental requirements, Governments are urged to adopt and implement, within the context of overall development policies, population policies which will contribute to redressing such imbalances.

22. Population objectives should be subordinate to and consistent with ultimate planning objectives and, therefore, national population goals should be made explicit so that consistent policies to achieve these goals can be more effectively designed and evaluated.

23. The Expert Group reconfirms the need for implementing primary health care measures, including family planning and observes that this will require co-operation and co-ordination in many areas outside the health sector. It therefore recommends that health planning should be integrated into national plans that take into account population, resources, environment and development.

24. The Expert Group recommends that consideration should be given, when appropriate, to establishing or strengthening national commissions on population and population units to link population policies and activities with other aspects of national development strategies and plans. It further recommends that the United Nations, its specialized agencies and other offices should strengthen their programmes of technical co-operation with the countries concerned in this field.

25. Educational and communication programmes should be developed which are designed to achieve a broad public understanding of the interrelations between population, resources, environment and development.



26. Co-operation between non-governmental organizations and local institutions, which allow locally available practical and scientific knowledge to be applied to resource and environmental problems, should be encouraged.

27. Governments are invited to encourage and facilitate, to the greatest degree possible, popular participation, particularly at the community level, in the formulation of plans and policies for socio-economic development.

#### Research

28. The Expert Group urges that improved methods should be developed for making long-range demographic projections, which take into account the interrelationships between population, resources, environment and development.

29. The Expert Group recognizes that studies of agricultural carrying capacity can be useful in both agricultural and demographic planning and policy formation since they involve an analysis of linkages between population, resources, environment and development. The Expert Group therefore recommends:

- (a) That the FAO methodology should be used to prepare descriptions of the actual situations in developing countries;
- (b) That Governments should make detailed country studies on food production potentials disaggregated by agro-ecological zones;
- (c) That Governments should make studies of their national potential for agricultural self-sufficiency.

30. Given the food needs of projected future population, the Expert Group recommends that research in the areas of forestry, crop varieties and tropical agriculture should be given priority. Other highly important research areas are farm size, land-tenure systems, market systems, life-styles and consumption habits.

31. Further research should be undertaken to determine the effects of increased farm prices on cereals production, the feeding of livestock and the state of nutrition.

32. That a very large portion of total grain production is now being used to feed livestock is a reflection of very substantial inequalities in purchasing power. The Expert Group therefore recommends that studies should be made of patterns of direct and indirect consumption of cereals disaggregated by different socio-economic classes.

33. The Expert Group recommends that previous experiences with new settlements, particularly in frontier areas, should be examined to determine ways of minimizing environmental and social costs.

34. In order to take advantage of possible complementarities, practical studies should be undertaken to explore the possibilities of joint food, biomass energy, export and animal production adapted to local conditions.



35. The Expert Group observes that the study of the interrelationship between equality and population, resources and the environment is constrained by a lack of statistical information disaggregated by social groups. It therefore recommends that a system of distributive statistics should be developed that would be linked to the System of National Accounts or the System of Social and Demographic Statistics already developed by the United Nations.

36. The Expert Group recommends that priority should be given to studies on the response of production and income distribution to the growth of population and other demographic variables.

37. The Expert Group observes that because of data incomparability and dynamic processes, it is difficult to estimate the relationships between population factors and income distribution using cross-country analyses. Therefore, it recommends that greater attention should be given to studying these relationships from a historical perspective.

38. Efforts should be intensified to study the socio-economic and cultural implications of advanced technology with a view to devising strategies to take maximum advantage of the beneficial aspects and to minimize its undesirable effects.

39. Developing countries should make substantial investments in research and development and should co-operate among themselves and with the developed countries in technological research. In this respect, the Expert Group further recommends that the developing countries should pool their resources by establishing joint research centres.

40. The Expert Group recognizes that social security systems in developed countries may face serious financial problems due to projected increases in the ratio of retired persons to workers. It therefore recommends that studies should be initiated to find methods of financing that would assure that these systems continue to be adequately funded.

41. The Expert Group observes that population variables are usually treated as exogenous in planning exercises and that therefore plans fail to take into account their effects on the demographic situation. It therefore recommends that greater emphasis should be given to research on the population consequences of broad development strategies.

42. A body of reliable methodologies for integrated planning of population, resource, environment and development programmes does not now exist and, therefore, the Expert Group recommends that research should be undertaken to develop such methodologies.

#### Note

1/ Report of the United Nations World Population Conference, 1974, Bucharest, 19-30 August 1974 (United Nations publication, Sales No. E.75.XIII.3), chap. I.



## ANNEXES







Annex I

AGENDA

1. Opening statements
2. Election of officers
3. Adoption of the agenda
4. Levels and trends in population, resources, environment and development: general discussion
5. Food and nutrition
6. Social aspects of development
  - (a) Income distribution
  - (b) Employment
  - (c) Health and education
  - (d) Social security
7. Resources and the environment
  - (a) Land-resource base
  - (b) Environmental degradation
  - (c) Non-renewable resources
8. Integrated planning
9. Overview of the discussion
  - (a) Population policy implications
  - (b) Non-demographic policy implications
10. Adoption of the report and recommendations
11. Closing of the meeting



Annex II

LIST OF PAPERS

<u>SYMBOL</u>	<u>TITLE AND AUTHOR</u>
IESA/P/ICP.1984/EG.III/CRP.1/Rev.1	Organization of work of the meeting
IESA/P/ICP.1984/EG.III/CRP.2/Rev.3	Provisional list of documents
IESA/P/ICP.1984/EG.III/CRP.3/Rev.3	Provisional list of participants
IESA/P/ICP.1984/EG.III/CRP.4	Provisional agenda
IESA/P/ICP.1984/EG.III/1	Annotated provisional agenda
IESA/P/ICP.1984/EG.III/2	Population, resources, environment and development: Highlights of the issues in the context of the World Population Plan of Action (United Nations Secretariat)
IESA/P/ICP.1984/EG.III/3	Impact of trends in resources, environment and development on demographic prospects (Nathan Keyfitz)
IESA/P/ICP.1984/EG.III/4	Population, resources and environment and prospects for socio-economic development (Mahar Mangahas)
IESA/P/ICP.1984/EG.III/5	Resources as a barrier to population (an analysis through 2000): an essay on explorations in alternatives (D.V. Ramana)
IESA/P/ICP.1984/EG.III/6	The effects of population growth on renewable resources (Roger Revelle)
IESA/P/ICP.1984/EG.III/7	Food production and population growth in Africa (ECA)
IESA/P/ICP.1984/EG.III/8/Rev.1	Selected aspects of population and development in the ECE region (ECE)
IESA/P/ICP.1984/EG.III/9	Development, life-styles, population and environment in Latin America (ECLA)
IESA/P/ICP.1984/EG.III/10	Population and development in the ESCAP region and some issues in their integration (ESCAP)



IESA/P/ICP.1984/EG.III/11	Prospects for meeting the challenges posed by the aging of populations (United Nations Secretariat)
IESA/P/ICP.1984/EG.III/12	Technical co-operation in the field of population and development (United Nations Secretariat)
IESA/P/ICP.1984/EG.III/13	Population and international economic relations (UNCTAD)
IESA/P/ICP.1984/EG.III/14	Interrelationships between resources, environment, people and development (UNEP)
IESA/P/ICP.1984/EG.III/15	Second study on industrial carrying capacity (UNIDO)
IESA/P/ICP.1984/EG.III/16	Population, resources and development (FAO)
IESA/P/ICP.1984/EG.III/17	Population growth, inequality and poverty (ILO)
IESA/P/ICP.1984/EG.III/18	Interrelationships between population, resources, environment and development (UNESCO)
IESA/P/ICP.1984/EG.III/20	Population and climate (WMO)
IESA/P/ICP.1984/EG.III/21	Assistance to projects on interrelationships between population, resources, environment and development (UNFPA)
IESA/P/ICP.1984/EG.III/22	Long-term effects of global population growth on the international system (Paul Demeny)
IESA/P/ICP.1984/EG.III/23	Population et environnement en Afrique: des approches indissociables (Jacques Bugnicourt)
IESA/P/ICP.1984/EG.III/24	Population, resources, environment and development: role of information, education and communication (UNESCO)
IESA/P/ICP.1984/EG.III/26	Choice of alternative paths to a stationary population: some economic considerations (Timothy King)
IESA/P/ICP.1984/EG.III/27	Population, environment and human needs (The National Audubon Society)



Annex III

OPENING STATEMENTS

A. Statement by the Executive Director, United Nations Fund  
for Population Activities and Secretary-General of the  
International Conference on Population, 1984

Awareness of the problems of the interrelationships between population, and other variables has increased vastly during the past decade, but we are still seeking a full understanding of the interrelationships themselves. It is particularly important to clarify the manner in which population as a primary factor is linked to resources, environment and development. It is true that a number of general policies based on these relationships have emerged, but they need to be refined. Once they have been conceptualized adequately, governments and international organizations will be able to develop effective programmes based on them. This Symposium should first refine the interrelationships; second, specify their causality; and third, recommend policies and operational measures.

The world has witnessed during the past 30 years an unprecedented demographic disequilibrium, brought about by the highest recorded rates of population growth in human history. Global population increased from 2.5 billion in 1950 to 4.6 billion in 1983 and is projected to reach 6.1 billion by the year 2000. With all the efforts to reduce fertility, global population is projected to stabilize at 10.2 billion by the end of the next century. These population trends are basic to the consideration of interrelationships.

Secondly, whatever the nature of the problems arising from interrelationships, they should not be allowed to deflect the developing countries from the path of development which they have chosen for themselves. The disparities between the developed and developing countries are growing: 90 per cent of the future increase in world population will occur in the developing countries. By the year 2000, 80 per cent of the world's population will be living in the developing countries.

Thirdly, it is necessary, as the World Population Plan of Action states, that "all countries, and within them all social sectors, should adapt themselves to more rational utilization of natural resources, without excess, so that some are not deprived of what others waste".

The first question confronting us is carrying capacity. How will we provide for the populations of the future? Taking the world as a whole, this may seem possible, but how is the geographical distribution of food production to be made to follow the geographical distribution of population? Will the inputs and technology available to the developing countries be sufficient for them to meet their food requirements? Can agriculture in developing countries become as productive as it is in the developed countries? We already have the technology to achieve this, but can the changes be made without adverse environmental effects?



Specific conclusions are needed to help Governments define their policy. For example, chemical fertilizers and pesticides have been in use in the developed countries for a long time now. Is it possible to work out policy guidelines on their environmental effects for the benefit of the developing countries?

On the other hand, if feeding the world's population is to depend on international transfer of food, how is a foolproof system to be developed? What mechanisms and agreements will be needed so that political considerations do not enter the transaction?

Another issue will be the development of human resources for the transfer of technology from the developed to developing countries. Man is both an agent and the object of development.

The issue of making people more efficient agents of the development process is therefore central to discussions on interrelations between population, resources, environment and development. While resource and environmental implications of population growth have received considerable attention in the past, the role of technology in integrating population with resources and environment and in promoting development need further analysis. Technology determines resource use and employment patterns, which are critical to solutions of some of the emerging problems of the developing countries. Technological change can also be an instrument of modernization, a condition favouring fertility declines, but a necessary condition for these changes is education and training in the new knowledge and skills, which will lead to improved use of machinery and equipment and increased productivity. Policy guidelines are needed in these areas also.

Finally, as long as there are disparities in standards of living and in life styles, the problems of interrelationships will persist. The ultimate purpose of development is to make possible a better life. When people are ill-fed, sick, underemployed and lacking the elementary amenities, they show little interest either in conserving resources or in protecting the environment. Just as much as resources and the environment, development should be considered the collective responsibility of the global community.

The International Conference on Population, 1984 will look to you, the experts, for guidance in these matters. Your brief conclusions should enable the Conference to identify critical areas, set out clear guidelines and recommendations for governments and international agencies, and help them develop the policies and programmes which will lead the world towards a harmonious and balanced future.



B. Statement\* by the Director of the Population Division,  
Department of International Economic and Social Affairs  
of the United Nations Secretariat and Deputy Secretary-  
General of the International Conference on Population, 1984

This meeting derives its special importance from the fact that it will provide the basic orientation of the conference in Mexico, by virtue of its subject matter. Its scope is as broad as it is profound: it is a matter of nothing less than the future of the world. New problems of unprecedented depth and scope, which do not fall within the terms of the traditional debates of this area, confront our generation; these problems bear with them the weight of the future.

Precisely because the range of issues before this meeting is so difficult to encompass, perhaps you will agree from the very outset on some understandings that respond to two principal obstacles that lie before us.

The first of these obstacles is the need to deal with the whole issue in five days and no more. There can be no question here of synthesizing all of the insights, understandings and recommendations that have emerged from the United Nations conferences of the last ten years and which have taken up the major questions of the environment, population, nutrition, employment, human settlements, and desertification. That would certainly be attractive and desirable under other circumstances, and you yourselves were selected on the basis of your multidisciplinary knowledge and experience. At some point, that synthesis will have to be made but it cannot be done here.

The second obstacle, would be to try to be too specific. For example, we cannot deal with population in the kinds of narrow terms used by demographers at their scientific conferences. Of course, you may decide to include among your recommendations that birth control should be encouraged everywhere or that the rate of population growth is still too high in the majority of third world countries. But it is essential that any such recommendation emerge logically from the consideration of the interrelations among the many variables at issue, bearing in mind that these interrelations are unlikely to have the same effect everywhere. If in many countries the question of food supply would justify a slowing or even a complete halt to population growth, you will nevertheless have to take care to avoid letting that observation be formulated as a universal slogan. We cannot neglect the great variety and complexity of situations that reflect the very uneven distribution of people across the face of the earth. That is one of the reasons for holding this meeting.

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\* Original in French



In the same way, there can be no question of dealing with environmental problems purely in and of themselves. As you know, there are some ecologists, who, in their eagerness for a global greening, entirely lose sight of the rest of the spectrum, or who narrowly deal only with particular resources such as energy. We must avoid falling into the error of some specialists who do not know that the world in which they live is different from that of their particular specialty. It is essential to go beyond narrow specialties and deal with interrelationships without, at the same time, trying to deal with everything.

Clearly, from the point of view of the Secretariat, the major difficulty of our meeting will be to avoid undue concern for synthesis on the one hand and undue specialization on the other. It is for you to decide precisely how to avoid the extremes.

I think that from the very outset we shall not have difficulty in agreeing that it is no longer possible to seriously consider any one of the four terms that identify the dimensions of our discussions - population, resources, environment and development - without placing them in the context of their mutual interrelationships. Moreover, it is necessary to consider the interrelationships on a higher level of complexity, richness and clarity.

The process of environmental deterioration is, in effect, a kind of chain reaction. Moreover, the links between the specific elements in the process are more important than the elements themselves. Among these linkages, we must clearly demonstrate how population is at the same time a cause of environmental problems and also one of their consequences, since after all, this meeting is intended to contribute to the substantive preparations for the forthcoming International Conference on Population in Mexico.

Another point which, in my view, calls for your attention, is the extent to which the three groups of factors - population, resources, environment - intermingle their effects on development, and conversely, the extent to which styles of development can influence population in different environmental and resource contexts.

In other words, it is the linkages that originate or culminate in an effect on population on the one hand, or which originate in or have a final effect on development in various demographic contexts, on the other hand, which call for your particular attention. Indeed, the essential theme of this meeting is "Population and Development", taking into account resources and environment, without the latter being treated as independent issues in and of themselves.

Clearly, we still have only a most imperfect understanding of the causal links between these factors, because of their great diversity and the increasing complexity of the phenomena in interaction, but we do know that our approach must be systemic, or holistic. It must take into account not only the increasing number and the quantitative characteristics of factors involved, but also the dynamic and changing nature of their interrelationships, their mutual feedbacks and interactions through time, as well as in the qualitative structure of these mechanisms.



The adoption of such a systemic approach leads naturally to the idea that the capacity to react to negative effects of interconnected factors must also be dynamic and must take into consideration the various combinations of factors. To spread the use of contraception or to exhort people not to move from rural areas into the great cities, without at the same time dealing with the physical, economic and institutional environment, would be to undertake policies doomed to ultimate failure. Such narrowly focused programmes would be insufficient in most cases.

You will surely agree that the time factor is essential in this area for environmental deterioration and the exhaustion of some resources are in general the results of a long process. Any counter-action can thus only be effective if it is also of a long duration. One cannot emphasize too much the fact that the key to the future is an effort launched sufficiently far in advance. In that way, those populations which have not yet begun to experience difficulties of maladaptation to their environment or their resource base may be able to avoid finding themselves in the situation of those countries which are already overpopulated or faced with the impossibility of surmounting the insidious effects of long term environmental deterioration. When such deterioration is unduly prolonged, situations which might generally be considered reversible may become irreversible, as the oceanographers remind us, for example. There are analogous points of saturation or of "no-return" in the relationships between population and resources. We do not know how and when it will be possible to bring about an ebb in the quantity of carbondioxide in the atmosphere. Top soil carried by runoff into the ocean is forever lost. The persistence of acid rain can cause irreparable damage to the environment. It is clear that there is less risk in acting now than in waiting until the damage has spread out, weakening in particular our food producing capabilities. It is essential to reflect well in advance on the course of events. If there is an area where we must be guided by informed anticipation rather than by simply following our past experience, it is here. I think, in particular, that you will agree that there is nothing to be gained by letting population pressures on resources and the environment continue to grow. The paper by Professor Nathan Keyfitz shows that population growth in the Third World during the last three decades has already had the effect of reversing the nutritional situation in the largest part of the Third World. Whereas they traditionally were exporters, they are now dependent upon other regions and have to use resources to feed themselves which could otherwise have been used for more dynamic contributions to development. How can Asia, where 80 per cent of the arable land is cultivated, and Africa, where, according to FAO, the quantity of food supplies available per capita has diminished by 10 per cent during the last ten years, be able to deal with the doubling and even tripling of population foreseen by our demographic projections? We must recall that the Third World has developed a potential for demographic growth that is so great that growth will inevitably continue throughout at least the first half of the next century. The basic question is how to respond to that projection. In a sense, we must now run against the clock.

I hope that we shall not devote too much time to cataloging the environmental ravages and resource waste that are already well known, or to problems of definition, and that you will quickly reach the core of the



subject. However, on one point of definition, you may wish to give the term "environment" a dynamic interpretation, considering it as the base of resource potential to be further developed by the application of new technologies.

Perhaps you will also agree to give the term "population" an enlarged meaning, one that is not purely demographic. The word "population" in many languages can have a demographic meaning or the broader one conveyed by the English word "people" or the French word "gens". This may be important, for it is clear that efforts to control the environmental deterioration or to conserve resources cannot be considered without reference to population in the broader sense, notably including the concept of community involvement at the village or town level. I should note that in the two preceding expert groups, a great deal of attention was given to such local community action, both with reference to the spread of family planning and to rural development policies intended to retain potential out-migrants or to encourage migration between rural areas or toward small towns and intermediate cities and away from metropolitan centres.

In these interrelations, we must consider population not only as the subject and the object of environmental degradation and resource exhaustion but also as the agency which may bring about a correction of these patterns of environmental deterioration and waste. After all, pollution is not a natural catastrophe - it results from activities of the population. The obstacles can only be political, economic or even cultural and there is no technical reason why they should not have an antidote. I think that we can now say that the relative success of efforts during recent years to deal with the energy crisis in the more developed countries by changes in life style and the discovery of new technologies is an encouraging sign. It shows that crises can be beneficial, if they lead to new solutions.

No one evolutionary path is inevitable and I think that we shall do well to agree that damage to the biophysical environment can be controlled by efforts at the micro-social level as well as at the macro-social and political levels. The limitations we encountered in the biophysical area must be placed in the political and social structures of countries and their interrelationships.

What is disturbing is that in the course of the last ten years, the population of the Third World has increased by 20 per cent while at the same time we observed an unprecedented deterioration of the environment, notably as a result of deforestation, the loss of soil quality and of desertification. Threats to the natural environment take an entirely different character in the Third World than in the developed countries and the means to remedy them are far more limited. Along with increasing pollution in the cities and the discoloration of the white marble of the Taj Mahal by acid rain, there are other threats that are less visible but much more fundamental. There is, for example, the exhaustion of the soil which seriously weakens the nutritional base of the society and which threatens by what it portends. For the future, the study of the interrelationships between the various factors of development shows once again that the Third World countries, where all such problems are exacerbated by demographic growth and by the unbalanced distribution of population in relation to resources, confront difficulties which the richer



countries did not experience or ignored at the time of their economic take off. The interlinkages produce a situation where any one difficulty may lead to others. For example, the supporters of organic farming warn against the abuse of chemical fertilizers, but to follow their advice blindly would be to give up any attempt to provide better nourishment for that quarter of all humanity who do not have enough to eat. Our objective is not simply to match the available food supply with demographic growth, but to surpass it, to eliminate the current deficit and to increase the availability of food.

Beside a future filled with promise in the Third World, we find many causes for concern. While the environmental problems confronting the developed countries arise especially from an excess of industrialization associated with uncontrolled technology, the problems facing the developing countries are especially those of underutilization of human and physical capital. The full potential of their wealth remains unrealized for they do not have access to the technology and means necessary for their exploitation. Industrial growth in the developed countries is not better controlled than demographic growth in the poorer countries, and threats to the environment and waste of resources are even more serious here. It is regrettable that the increase in carbondioxide in the atmosphere should have come about more because of the industrialization of the rich countries than from the conversion of fallow into arable lands in the developing countries or even from the deforestation of these latter. The rich countries have a great deal of responsibility for the deterioration of the common goods of the atmosphere and the oceans, which could profit all, are no one's personal property, and are indispensable for the continuation of life on earth. The rich countries have taken far more from nature than have poor countries. Excessive consumption in the rich countries is directly in competition with the quality of life for our generation and for those to follow. This is a point that you may wish to examine.

There are also other vital problems on the proposed agenda.

There is the matter of health in the Third World. It is clear that millions of persons lose their health or even their life because of diseases which medical technology could deal with, but which are aggravated by environmental conditions. In the area of health, as in many others, the contrast between the industrial and the developing countries is striking. There are two worlds and two patterns of pathology. In the first world, the pathologies of the rich predominate - cardiovascular, carcinogenic and degenerative diseases; in the second, it is the pathologies of the poor that flourish, especially malnutrition, communicable diseases and those of the environment. In particular, the shortage or pollution of water plays an important role. Unfortunately, water-borne diseases are often poorly identified or understood by traditional societies.

Environmental degradation due to the expansion of irrigation, which spreads bilharzia, jeopardizes the remarkable medical progress of the last 50 years. But it must also be recognized that medical progress leans more and more toward the use of sophisticated and expensive treatment, a prerogative almost exclusively of the laboratories and hospitals of the rich countries reserved for the more affluent. Moreover, too much attention is given to the



cure of disease and not enough to changing the environment in such a way as to prevent disease.

Another inescapable problem for your discussions is uncontrolled and accelerating urbanization in the Third World, where it reaches truly monstrous proportions, while the industrial countries are experiencing urban deconcentration. By the end of the century, 20 of the 25 largest cities of the world will be found in the Third World. Europe, the cradle of urbanization, will disappear from the list. The largest cities of the industrial world have experienced a slower rate of growth or even some reduction for some dozen years now. The slowing of urban growth in these countries is tied to the development of new technologies for storing and communicating information; it leads to new forms of spatial distribution linked to new patterns of social life. Rural areas of these countries enjoy an increasingly urban life style.

About half of the urban concentration in the Third World is the result of natural population growth and about half due to migration from depressed rural areas. This migration is in effect the transfer of underemployment and misery from the countryside into the cities, and it will remain thus to the extent that the rural areas do not become the focus of a policy of rural development. As miserable as may be the conditions of migrants in the cities of the Third World, the situation appears to them to be less desperate than in the countryside, where there are only the most scant prospects for employment.

You may perhaps respond with some caution to the ritual calls for the salvation of humanity - which are all too often mutually contradictory and based on insufficient information. However, one cannot help but think that if the threats do prove to be true, it may be too late to do anything about it; it is worth considering that there may be real gain, and in any case nothing to lose, by taking these threats seriously. The dangers, serious as they may be, cannot in any way restrain the increasing mass of needs. The most menacing is the prospect of increased carbondioxide in the atmosphere, with possible consequences for the climate and in turn for the vegetation, the hydraulic cycle and ultimately for the full set of relationships between population and subsistence in the future.

This environmental degradation is the first threat at a global scale. It leads to the idea that for the future, it is essential to treat our basic problems at a global level, and I see two consequences that you may wish to consider.

The first is that it is urgent to launch a system of continuous monitoring and reporting that is equal to its tasks by means of a co-ordination of all of the various relevant sectors. The reporting system must provide a basis for research that will permit the verification of the hypotheses it produces. Research must be undertaken to specify risks and possible outcomes, establish priorities, and propose programmes of action to avert the risks and to surpass them.

The second consequence is that the globalization of problems will lead to stronger links of dependence between countries, and thus necessarily of



controls. There may follow new responsibilities, new rights and new duties on the part of Governments to provide some degree of global management.

Finally, it remains for me to say that my colleagues of the Population Division and I shall be most happy to assist you in your discussions; we look forward with the greatest of interest to your contribution to the strengthening of the World Population Plan of Action.



Part Two

BACKGROUND PAPERS







## I. GENERAL OVERVIEW

### A. Population, resources, environment and development : Highlights of the issues in the context of the World Population Plan of Action

United Nations Secretariat\*

#### Introduction

At the World Population Conference held at Bucharest in 1974, statesmen were beginning to stress the importance of understanding the linkages between population, resources, environment and development. Since that time, other meetings have further illuminated these linkages. To an ever-increasing degree, the demographic community has translated the issues they introduce into the study of the determinants and consequences of fertility, mortality and migration. Researchers have now accumulated much more information on levels and trends in each of these four factors, and from that information have learned more about their interrelationships.

In this introduction, the conferences that provide a background for the meeting of the Expert Group on Population, Resources, Environment and Development are briefly reviewed, and recent levels and trends with respect to these factors are highlighted and discussed along with the concepts of carrying capacity and optimum population. The role of population is delineated and the content of the four substantive sections of the paper is described briefly.

The acceptance by the international community of the importance of the interrelations between population, resources, environment and development has been in large measure an outgrowth of the search for development alternatives that would reduce the disparities between developed and developing countries and ameliorate poverty within countries. A series of international conferences convened in the 1970s and early 1980s advanced our understanding of development as a complex, multi-dimensional process involving strong interrelations with population, resources and the environment.

Initiating this process was the Conference on the Human Environment, held at Stockholm in 1972, in which it was noted that in many countries underdevelopment was, in itself, an environmental problem. The conference called upon States to adopt an integrated approach to planning which would ensure that development should be compatible with the need to protect and improve the environment for the benefit of their populations.<sup>1/</sup>

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\* Population Division, Department of International Economic and Social Affairs, United Nations



The role of population was introduced explicitly in two symposia held in the following year, on population and development at Cairo, and on population, resources and the environment, at Stockholm. The first gathering examined the effects of social and economic development on population trends, as well as the impact of population growth on economic development.<sup>2/</sup> The second recognized that natural, institutional and political factors posed barriers to human development, the elimination of which was rendered more difficult by rapid population growth.<sup>3/</sup>

Consistent with the work of the two symposia, the World Population Conference in 1974 gave recognition to population as a critical element in solving the problem of preserving the environment and available natural resources and suggested that the supplies and characteristics of natural resources and the quality of the natural environment should be considered in formulating population goals and policies.<sup>4/</sup>

Shortly thereafter, a symposium was convened at Cocoyoc, Mexico, to consider whether the outer limits of the planet's resources might not be at risk. It called upon the world's statesmen to move towards a new system more capable of meeting the inner limits of basic human needs for all the world's people, without at the same time overtaxing the planet's resources and environment.<sup>5/</sup> In the same year, 1974, the World Food Conference at Rome stressed the importance of adopting measures urgently needed to increase the output of food while protecting land and water resources and considering the effects of alternative technologies on the quality of the environment.<sup>6/</sup>

The United Nations Conference on Human Settlements, meeting at Vancouver, B.C., emphasized that while providing for the satisfaction of basic human needs, such as shelter, due concern should be given to protecting the environment, the common heritage of all mankind.<sup>7/</sup> And in addressing an equally important human need, the International Conference on Primary Health Care, held at Alma-Ata, Union of Soviet Socialist Republics, noted that improvements in health and in socio-economic development were mutually supportive. In particular, anti-poverty measures, food production and environmental protection all contribute to health.<sup>8/</sup>

In 1977, the United Nations Water Conference at Mar del Plata, Argentina, focused attention on the need for scientific, systematic and comprehensive studies of the impact of water and other development projects on the environment and other natural resources.<sup>9/</sup> And in the same year, the United Nations Conference on Desertification, at Nairobi, pointed out that climatological and ecological aspects were only part of the desertification problem, citing the need to consider social, economic and political factors as well.<sup>10/</sup>

Many of these themes were brought together in the United Nations Symposium on Interrelations: Resources, Environment, Population and Development, held at Stockholm in 1979 at the invitation of the Government of Sweden. Viewing man as both the agent and the object of development, the Symposium recognized that the interaction of rapid population and economic growth could lead to a continuing degradation of the environment and diminished resource productivity. But the Symposium also concluded that the



earth's carrying capacity could be expanded through technological advances combined with the management of resources and careful development strategies. In particular, the Symposium noted that a greater understanding of the interrelationships between population, resources, environment and development would help to identify points of leverage for the application of appropriate policies.11/

In order to generate such proposals for action, the United Nations Environmental Programme (UNEP) convened a high level group on interrelations, which met in 1980 and 1981 and drafted an action-oriented programme of work for the United Nations with regard to these interrelationships.12/

Since that time, there have been two other United Nations Conferences bearing on the work of this Expert Group. In May of 1982, a Session of a Special Character of the Governing Council of UNEP was held at Nairobi to assess progress; it concluded that the Stockholm Action Plan for the Human Environment had been implemented only partially, and called for improved environmental assessment and management.13/ Later in the same year, the World Assembly on Aging, held at Vienna, examined the humanitarian and developmental issues related to the aging of individuals and of populations.14/

These international conferences, which have set the stage for the meeting of this Expert Group, also provided many of the themes for the International Development Strategy for the Third United Nations Development Decade.15/ The International Development Strategy recognized that accelerated development could enhance the capacity of the less developed countries to improve their environment and insisted that, in addition to the environmental implications of poverty and underdevelopment, the interrelationships between development, environment, population and resources must be taken into account.

In preparation for the International Conference on Population to be held in 1984, it was imperative that an attempt should be made to clarify the part played by population in this complex and almost seamless web of interrelationships. To facilitate this task, a brief review is given here of the important trends in population, resources, environment and development.

In the decade between 1970 and 1980, world population grew from 3.7 billion to 4.4 billion.16/ By the year 2000, this figure is projected to reach 6.1 billion, growing to 8.2 billion in 2025 and ultimately achieving stability at approximately 10.5 billion persons in about 2110.17/ These projections assume a declining rate of population growth, falling from an annual rate of increase of 1.7 per cent in 1980 to 1.5 per cent in the year 2000 and 1.0 per cent in 2025. However, it is important to recall that because of the continuing growth in the base population, the absolute increments to world population will still be very large, 78.8 million persons annually in the period 1980-1985, and will peak at 88.4 million in the 1995-2000 period. In the developing countries, the absolute increase in population is expected to peak at 82.8 million in the 2000-2025 period.18/

The growth rates of total world population conceal the great diversity between the developed and developing countries. In the former, the growth rate was .7 per cent in 1980 and is projected to fall to .5 per cent in the



year 2000, while in the developing countries the annual growth rate was 2.1 per cent in 1980 and is projected to decline to 1.8 per cent in the year 2000. Consequently, the proportion of the world population living in the less developed countries will increase from about three fourths in 1980 to four fifths in the year 2000.

The recent slowing in rates of population growth has largely been due to declines in fertility, with the result that the median age of world population has been increasing. It is projected that this figure will increase from 22.6 years in 1980 to 26.1 years in 2000. As a consequence of the aging of world population, overall age dependency ratios are expected to decline. Increases in the dependency ratio of the 65 years and older group will be outweighed by declines in the dependency ratio of the 15 years and younger age groups.

In years past, the needs of a rapidly growing population have been largely met by an even more rapid growth in world output. However, this decade follows two previous decades of decelerating rates of growth of production. If recent trends were to continue, projections made by the United Nations<sup>19/</sup> indicate that annual growth rates of production between 1980 and 2000 would average 2.6 per cent for the developed market economies, 3.5 to 3.6 per cent for the developed centrally planned economies and 4.8 per cent for the developing market economies. The last figure is significantly lower than the 7 per cent called for by the International Development Strategy. Continuation of current trends would imply annual rates of growth of per capita income of about 2 per cent in the developed market economies and 3 per cent in the centrally planned and developing economies.

Prospects for future production are, of course, intimately linked with expected supplies of labour, capital and natural resources as well as the pace of technical change. With regard to labour, the International Labour Organisation (ILO) projects that the world's labour force will increase from 1.8 to 2.5 billion between 1980 and the year 2000, while the labour force in developing countries will increase from 1.2 billion in 1980 to 1.9 billion in the year 2000.<sup>20/</sup>

If the rates of growth of output called for by the International Development Strategy are to be realized, investment levels will have to increase in all countries over levels achieved between 1960 and 1980 until rates of investment reach 28 per cent of their gross national product in 1990. At the same time, the productivity of new and existing capital will have to be raised. However, the United Nations estimates that a continuation of recent trends will involve lower rates of investment and lower productivity of investment.

The following trends with regard to natural resources can be discerned. Estimates of the world's arable land potential indicate that roughly half is currently under cultivation, most of the potential arable land reserves being in Africa and Latin America. Since 1970, growth in the catch of fish has been erratic and slow, leading to a decline in per capita consumption. Closed forest and other woodlands now cover about 4,000 million hectares of world land, but approximately 12 per cent of tropical forest is likely to disappear by the year 2000.<sup>21/</sup> Between 1950 and 1973 annual production of petroleum



increased from 1.5 barrels per capita to 5.3 barrels per capita. Since that time the quadrupling of world oil prices has reduced the growth in levels of petroleum production below rates of population growth.<sup>22/</sup> There remain, however, large reserves of natural gas and coal and a variety of other energy sources are available. Supplies of non-fuel minerals would also appear to be adequate for many decades to come, even though prices may rise.

Primarily through the destruction of habitat, it is estimated that between 1980 and 2000, one million species of plants and animals now inhabiting the planet will be permanently lost.<sup>23/</sup>

Trends with regard to the environment are more difficult to assess. However, it has been estimated that if unchecked, desertification would triple the current world desert area (792 million hectares) by 2000.<sup>24/</sup> In irrigated areas, waterlogging, salinization and alkalinization affected some 111.5 million hectares in 1975. If recent trends were to continue through 2000, an additional 3.1 million hectares would be damaged.<sup>25/</sup>

In 1976, the atmospheric content of carbon dioxide was estimated at 332 parts per million by volume. This represents an increase of about 5 per cent over the preceding 20-year period and a significant increase in levels are projected for the year 2000.<sup>26/</sup>

Before proceeding to a discussion of the interrelationships between population, resources, environment and development, it would be useful to review each of these concepts. In the context of the work of the Expert Group, the term "population" refers not only to the number of persons and their location, age and sex composition, but also to their socio-economic characteristics such as levels of education, health and family status. The term "development" refers to an integrated process of interrelated economic, social and political change, the ultimate aim of which is the constant improvement of the well-being of the entire population. This would imply full participation in the process of development and a fair distribution of the benefits therefrom. The term "resources" includes human resources, capital goods and natural resources, the latter being components of nature which can be used in the productive process. For purposes of discussion, this paper treats resources as an aspect of the environment. The environment would thus be conceived of as the ecosystem that both supplies resources and acts as a repository for the wastes generated by consumption and production.

Among the fundamental concepts to be dealt with by the Expert Group, is the notion of carrying capacity, defined in the paper prepared by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as the level of population that may be supported by a country at a given level of welfare, that is, the number of persons sharing a given territory who can, for the foreseeable future, sustain a given physical standard of living. This is a dynamic concept which may be extended - or restricted - through changes in cultural values, technological advances and changed economic and social systems, not to mention the emergence of a new political will. Keyfitz, in his paper, emphasizes that the notion of carrying capacity on a local scale is rendered inapplicable by the world market in foodstuffs and has to be transformed into a relation between population and all resources. However



defined, the carrying capacity of the world, or any of its parts, must be distinguished from the notion of an optimum population, the number of people that at different points in time could be most efficiently supported with total available resources and technology.

In examining interrelationships between population, resources, environment and development, it must always be kept in mind that population trends not only affect these other factors but are profoundly affected by them. The impact of development in conjunction with changes in the environment and resource availability have been carefully reviewed in the documentation for the Expert Groups on Fertility and Family, Mortality and Health Policy, and Population Distribution, Migration and Development. Therefore, this paper concentrates on the role played by population in conjunction with other factors in determining trends in development, resources and the environment and, in particular, focuses on the effects of changes in the size and age structure of populations, the other major demographic variables having been the subject of the other Expert Group Meetings.

Though many issues will be discussed, a central theme must be the determination of trends in population size and age structure that would seem both feasible and desirable, given the resource requirements and environmental implications of such developmental objectives.

A number of scholars have prepared mathematical models purporting to demonstrate that though slower rates of population growth would have short-term advantages, over the very long-term (centuries) higher rates of population growth may be more beneficial to mankind.<sup>27/</sup> Others have argued that current rates of population growth may not merely be an obstacle to improved levels of welfare, they may be an absolute barrier. Arguing that the current demographic path we are on cannot be sustained, they call for establishing goals for slowing population growth. Lester Brown, for example, has suggested that population size should ultimately be stabilized at about 6 billion persons.<sup>28/</sup>

Are we approaching the limits of the capacity of the planet to support the legitimate demands of an increasing number of people? Or can we expect that the pressure of increasing numbers of people would release technological responses which would extent this limit?<sup>29/</sup> If Governments in their planning and policy-making are to take an informed view of the nature of population pressures, ways must be found to determine how persons can be supported at an appropriate level of living in various parts of the world as we move into the future.

It is not an easy task to draw up an agenda for a discussion of interrelationships and it may appear that a topical approach has been chosen. However, it should be stressed that each issue dealt with is viewed as a selected example of key problem areas, the understanding of which is better revealed when considered as an aspect of the holistic and synergistic character of the interrelationships. Perhaps the most important task of this Expert Group is to identify more clearly the role of population within these interrelationships. That is, to identify through which mechanisms population characteristics condition and are conditioned by resource use, environmental



effects and the developmental structure. This requires an approach going beyond inquiries into the determinants and consequences of demographic change, involving a systems approach in which all factors are treated simultaneously and in which the closing of loops through feedback effects is of foremost importance.

It is in this spirit that the topics discussed in this document are presented. The division we have chosen is not arbitrary. To a considerable extent the incidence of poverty forms the root cause of many of the problems derived from the interrelationships between population, resources, environment and development in developing countries. Conversely, affluence appears to be the major cause of many of the environmental and resource problems in the developed countries. Consequently, we have decided to devote the first two substantive sections to issues considered crucial in the alleviation of poverty. Lack of food, adequate nutrition, health care, education, gainful employment, old-age security and adequate per capita incomes perpetuate poverty of large numbers of people in developing countries and therefore also their production and consumption patterns which undermine, through environmental and resource degradation, the very resources on which they depend for their livelihood. The latter process and the environmental and resource problems that are the result of affluence are further described in the next section where the environment is viewed both as a supplier of resources and as a repository of wastes.

The discussion of environment as a provider of resources first considers supplies of minerals, energy and water. Attention is then turned to the stock of agricultural land that can be expanded through fertilization and irrigation and which may be reduced as a result of desertification, deforestation, urbanization, salinization and waterlogging. In considering the environment's role in regard to waste products, special attention is paid to impacts on those parts of the environment that people share in common, the air and the waters. The fourth substantive section focuses on the need for integrating population variables into development planning. In the formulation of long-term development objectives, population can no longer be viewed as an exogenous force, but rather becomes an endogenous variable which affects and is affected by development policies, programmes and plans. However, short-term development plans have long-term consequences for population variables and these long-term changes in population variables do affect long-term development plans. Finally, it should be stressed that the contents of this document are based on an overview of those contributed papers that were available to the United Nations Secretariat by 1 March 1983.

#### Food and nutrition

The World Population Plan of Action stresses the need to give particular consideration to all aspects of the supply of food in the formulation of national population goals.<sup>30/</sup> Looking at this from another perspective, the World Food Conference recognized the need to achieve a desirable balance between population and food supply. It called upon Governments and people everywhere to grow, and to distribute equitably, sufficient food and income so that all mankind might have an adequate diet while at the same time supporting



national population policies.<sup>31/</sup> Furthermore the elimination of hunger and undernutrition by the end of this century is one of the main objectives of the International Development Strategy for the Third United Nations Development Decade.<sup>32/</sup>

Studies carried out by the Food and Agriculture Organization of the United Nations (FAO) (part Two, III, D) show that for the world as a whole, and for the developing countries in particular, the total food production potential of arable lands is sufficient, even at current low technological levels, to provide an adequate and nutritious diet to the present total world population, and that growth in world food production can remain abreast of projected world population growth. However, this study also indicates that numerous individual countries will not be able to live within the bounds of their national carrying capacities. Nowhere is this more true than in Africa where, in the year 2000, under even the most optimistic technical alternatives 30 out of its 51 countries will experience food deficits and their populations will exceed the maximum carrying capacity of the land to produce food by one third.

In spite of the adequacy of total world agricultural food production, it is estimated that currently about 400 to 600 million persons are undernourished. In Africa, in particular, the picture is darkening as population growth rates have been outstripping food production growth rates. The document contributed by the Economic Commission for Africa (ECA) jointly with FAO (part Two, III, C) observes that in Africa "during the period 1970 to 1976 population growth rates were greater than food production growth rates in two thirds of the countries". The result has been that over the past two decades food consumption in Africa has fallen below nutritional requirements.

The growth in population is but one of a complex pattern of interacting factors leading to sub-optimal production and distribution of food and hence to widespread malnutrition. In order to better assess the role played by population growth, the paper by FAO mentioned above examines two alternative demographic scenarios, making use of its study Agriculture: Towards 2000, which maps out alternative possibilities for the development of the world's food and agriculture up to the end of the century. The study found that the reduction in total agriculture demand was roughly proportional to the reduction in population, whereas there was little impact on production, since lower rates of population growth would have little impact on the agricultural labour force in a 20-year period. The study found that decreases in population growth may relieve pressure on agriculture and could "mean an improvement in the agricultural trade balance thus ensuring release of foreign exchange". However, the study warned that the end of the population explosion should not foster any false hopes that the task for world agriculture to produce sufficient quantities of food would become less difficult; only that it would become slightly more manageable.

The ECA paper mentioned above provides a list of a number of major non-demographic policies which ought to be considered in agricultural management; otherwise a crisis situation in regard to food and nutrition could arise. Among the issues cited are the "worsening of climatic conditions through mismanagement of the environment, indiscriminate cutting of trees,



over-grazing, and poor husbandry and farming methods". The paper continues by suggesting the adoption of policies to motivate the population to expand the stock of cultivable land. It advocates policies to redress the imbalance between food production for domestic use and cash crop production, practices designed to reduce post-harvest food losses, improved and comprehensive policies on agricultural extension services, backed up by the availability of simple but improved implements and improved seeds, and by access to fertilizers and irrigation. Closely allied to this would be policies to improve all aspects of rural infrastructure from road networks to health services. And relevant both to the question of meeting nutritional needs and to achieving an equitable social order is the improvement of land-tenure systems.

The FAO paper suggests that the most important non-demographic policy question may concern prices. In particular, the impact of subsidizing food prices for urban consumers must be assessed in terms of its effect on decreasing food production, encouraging urbanization, depressing farm gate prices, increasing food imports and intensifying balance-of-payment problems. Viewed from a different perspective it might be asked, to what extent would high farm prices stimulate agricultural production and curtail use of cereals for animal feed? Conversely, to what extent would those high agricultural prices aggravate the nutritional problems of the poor?

An important policy objective relating to food and nutrition is the pursuit of national self-sufficiency in food production. However, such a goal is controversial, since it could sacrifice the gains from specialization implied in the principle of comparative advantage. But as Keyfitz points out (part Two, I, B), there has been a progressive concentration of world agriculture in a few mostly developed countries. He notes that in the short run cheap grain can avert starvation, but in the long run it can build up large urban populations in the developing countries leaving them defenceless against crop fluctuations and high interest rates. He contends that the current system of international food dependence is a source of international instability whereby populations may go hungry as a result of declines in world market commodity prices over which they have very little influence.

The paper contributed by the United Nations Conference on Trade and Development (UNCTAD) (part Two, IV, B) notes that unrestricted international trade promotes a more efficient use of the world's resources, leading to increased productivity and growth. But this requires a stable and liberal international trade environment, and recent experience raises doubts as to whether it would be advisable to follow a strategy based on comparative advantage.

If developing nations are to aim for self-sufficiency in food production, it will be necessary in most cases to embark on even more ambitious programmes of agricultural modernization. It will become even more necessary to do this in a way that avoids the environmental pitfalls that will be discussed in a later section of this paper.

Furthermore, employment opportunities will have to be created outside the agricultural sector since agricultural modernization generally implies that



fewer people will be working in agriculture. The non-demographic policies described above will have to be pursued with greater intensity and, given the goal of self-sufficiency, Governments may also wish to consider intensified efforts to slow rates of population growth. As noted in the paper by ECA, lowering population growth per se is not a sufficient or essential condition for solving food and nutritional problems, but slowing these rates of growth can render the task of solving these problems less difficult.

The paper prepared by FAO, while recognizing a causal link between population growth and food scarcity, points out that income gains in the last two decades far out-distanced population increases and that these increases in income have resulted in an intensification of the competition between food grain and feed grain production. Eckholm cites a study by the United Nations Children's Fund (UNICEF) which would indicate that undernutrition can be eliminated by providing the poor with an additional 2 per cent of the world's grain output, while one third of the world's grain is currently fed to livestock and poultry.<sup>33/</sup> But, as pointed out in the FAO paper, the great bulk of animal feed is used in the developed market and socialist countries, and the feasibility of transferring any large portion of this production to developing countries is questionable. Therefore, FAO states that the greatest opportunity for increasing the availability of food grains to the poor in developing countries lies in changes in consumption patterns by the middle class in these same countries.

Closely related to the issue of the competition between food and feed grains is the potential future competition from energy crops. Brown points out that "to the extent that energy crops divert land and other agricultural resources from food production, they will surely drive food prices upwards".<sup>34/</sup> Brazil has moved forcefully towards achieving self-sufficiency in automotive fuel by producing alcohol from sugar cane. While planting only 2 per cent of the land area of that country with sugar cane would be required to achieve this goal, that would represent almost a 50 per cent increase in the total crop area of that nation.

It is clear that the world's capacity to meet the food needs of an increasing population will depend to a great extent on developing appropriate patterns of meat and energy consumption in response to increasing per capita income. Convincing people to respond to economic development with different life-styles will be a necessary but exceedingly difficult task, the dimensions of which can be reduced by a slower rate of population growth.

### Social aspects of development

#### Education and health care

Although the provision of food is essential in eliminazting hunger and undernutrition, the concept of carrying capacity goes beyond the simple notion of the ability of world agriculture to feed the world population. Equally important is the provision of an adequate standard of living to all people. Although there are many aspects to the improvement in standards of living, for illustrative purposes attention is focused here on education and health care,



which are essential ingredients in the overall development process and for which requirements increase as population grows. Provision of education and health care not only places demands on the carrying capacities of nations in terms of the creation of capital equipment and infrastructural networks, but also increases the carrying capacity because both contribute to productivity.

As pointed out by Mangahas (part Two, IV, A) education and health represent not simply consumer demands for services but also long-term investments in the human capital of a society. This view is also reflected in the World Population Plan of Action, which recommended that in planning measures to harmonize population trends and socio-economic change, it must be recognized that investment by nations in the health and education of their citizens contributes substantially to productivity.35/

Recognizing that the demand for educational services was expected to increase considerably and that there existed a great many children who ought to be in school, the framers of the World Population Plan of Action stated unequivocally that the supply of educational services must be increased.36/

The International Development Strategy for the Third United Nations Development Decade calls for universal education on the broadest possible scale, eradication or considerable reduction of illiteracy and the closest possible realization of universal primary school enrolment by the year 2000.37/

In 1980 the rate of primary school enrolment (ages 6 to 11) amounted to 74 per cent in the developing countries and 94 per cent in the developed countries. The rate of secondary school enrolment (ages 12 to 17) in 1980 was 43 per cent for developing countries and 87 per cent for the developed countries. The adult literacy rate was 59 per cent in the developing countries and 98 per cent in the developed countries.38/

In addition to its educational goals the World Population Plan of Action adopted the reduction of morbidity and mortality to the maximum feasible extent as a major goal which every nation should achieve in conjunction with massive social and economic development.39/ The International Conference on Primary Health Care at Alma Ata endorsed the target of health for all by the year 2000, which among other things would entail bringing infant mortality below 50 per 1000 for all identifiable sub-groups and a life expectancy at birth of at least 60 years.40/ Great progress will be required if those goals are to be achieved. At present in at least 29 developing countries infant mortality exceeds 160 per 1,000 live births, and life expectancy at birth is 45 years.41/

Mangahas notes that current trends towards reduced fertility and hence lower rates of population growth in many developing countries will make it easier to achieve these goals. Furthermore, parents will be able to afford schooling for their children on account of later marriage, making for a better conjunction of schooling expenditures with the life-cycle of income. He also notes that lower fertility will reduce health risks to mothers and infants.

Mangahas also emphasizes the fact that the nature of the requirements for health and educational services is strongly influenced by the age structure as



well as by the size of the population. And he notes that in the demographic transition the proportion of the young people in the population tends to increase up to a point, followed by a relative increase in the working age population. Mangahas further observes that in the less developed countries the proportion of the population of school age may have passed its peak, and cites Gavin Jones' projection that this proportion will fall from 25 per cent in 1980 to 23 per cent in the year 2000.

From the standpoint of health care, Mangahas notes that the changing age structure implies a transition in relative importance of the functions of disease prevention, cure and care. The geographic distribution of the delivering of health care and education is also an important variable. Although much attention has been paid to unsanitary living conditions in urban areas, the incidence of morbidity and illiteracy is in most instances worse in rural areas. It is for this reason that the World Population Plan of Action stressed the importance of extending health services to rural, remote and underprivileged groups.42/

Mangahas observes that though health and education activities are not necessarily done more efficiently by government than by the private sector, it is important that Governments take the leading role in providing these services because heavy government involvement in activities that produce health and educational capital for families is a manifestation of the social commitment to distributional equity. He argues that government participation may raise national investment in health and education to higher levels than would otherwise prevail while allocating these services to households according to social equity criteria. These activities thus can be viewed as a means of transforming the existing socio-economic class structure into a more equitable one through fiscal redistribution of investment benefits and costs.

Eckholm cites data indicating that as of 1980, 25 per cent of the third world's urban population (excluding China) lacked reasonable access to water, while the corresponding figure was 71 per cent in rural areas. Similarly, that in 1980 decent waste disposal facilities were lacking in 47 per cent of urban and 87 per cent of rural areas of developing countries. Though the percentage of persons having access to sanitary water and waste disposal facilities had increased during the previous two decades, the absolute number of persons so deprived increased as a result of population growth.43/

The 1980s has been proclaimed the International Drinking Water Supply and Sanitation Decade (General Assembly resolution 35/18 of 10 November 1980). But achieving the goal of providing access to all mankind to safe water supplies and sanitary means of waste disposal by the year 1990 would not only require effective political leadership at local and national levels and a shift of emphasis to rural areas, but also many billions of dollars worth of investment in infrastructure. If progress in this area is to keep pace with projected increases in population, these efforts must be made. Slowing rates of population growth can serve to make the task more manageable.



## Employment and income

This section covers three interrelated aspects of the distribution of the gains from development. They are: (a) the provision of adequately paying employment opportunities to young entrants into the labour force; (b) the provision of adequate social security for those who have completed their working years; and (c) the general question of inequalities in the distribution of income. It is clear that these issues involve not simply the size and location of populations but also their age structures.

Employment. The World Population Plan of Action pointed out that the increasing proportions of young people in the populations of developing countries required the framing of appropriate development strategies, priority being accorded to incorporating these young people into the labour force through the attainment of full employment.<sup>44/</sup> And the International Development Strategy for the Third United Nations Development Decade has the achievement of full employment by the year 2000 as one of its primary objectives.<sup>45/</sup>

Achieving this goal will be no easy task, as ILO projections show the labour force of developing countries increasing from 1.2 billion in 1980 to 1.9 billion in the year 2000.<sup>46/</sup> In other words, the creation of 700 million new productive jobs will be required in developing countries to meet the needs of a growing labour force without touching the current backlog of unemployment and underemployment in those countries. The problems of unemployment and underemployment in rural areas due to increasing landlessness has further intensified as a result of agricultural modernization.<sup>47/</sup>

Because of young age structures in developing countries, the average annual growth rate of the labour force over the period 1980 to 2000 will be 2.6 per cent, a figure that is substantially higher than their annual growth rate of population. Because of their slower rates of population growth, the developed countries face employment problems of a smaller magnitude. Between 1980 and 2000, they must find employment for 100 million new entrants into the labour force.<sup>48/</sup>

Rates of growth of the labour force may determine requirements for employment, but they are by no means the sole explanation for high levels of unemployment. The paper contributed by the Economic Commission for Europe (ECE) (part Two, IV, H) notes that even the slow labour force growth in many West European countries in the 1970s did not prevent very high rates of unemployment in the 1980s. It goes on to say, however, that the average annual increase in persons of working age is projected to drop by nearly 40 per cent in the second half of the 1980s and that the current relative oversupply of potential young workers may turn into an acute shortage of new entrants into the labour market within the next few years.

In the developing countries, the problem is not simply one of finding a sufficient number of employment opportunities but of providing high productivity employment, with rates of remuneration sufficient to lift the worker and his family out of poverty. Given current trends in agriculture, it is likely that many of these new entrants to the labour force will have to



find employment in industry. This will both require substantial expansions in industrial capacity and place increasing pressure on the resource base and the environment.

The paper submitted by the United Nations Industrial Development Organization (UNIDO) presents the findings of a recently revised study using its LIDO model to develop an economic scenario for the achievement of the Lima targets (see A/10112) for locating 25 per cent of manufacturing value added in the developing regions (part Two, III, F). This scenario was used to assess the development of labour force requirements by economic sectors and regions up to the year 2000. The major result of this study is that the implied high economic growth rates will make it possible to fully absorb the available labour force by the year 2000. That is, the increase in employment opportunities will be sufficient to provide work for the rapidly growing labour forces of the third world. In fact, the model indicates that by the year 2025, there would be an excess demand for labour of 8.9 per cent in the developing and 4.8 per cent in the developed countries. Thus, the UNIDO study points to the conclusion that unemployment may not be a problem, at least at a global level, if the world economic scenario generated by the model were to become a reality. This would require a large expansion in industrial capacity as well as the development of urban infrastructure. Even if one assumes that population trends permit health and educational targets to be met, so that the labour force is of sufficient quality to be used in a highly productive manner, the capital requirements would pose severe constraints.

Although it is agreed that, in general, the most appropriate approach to industrialization is by means of labour-intensive production processes, increased capital per worker is necessary if productivity is to be increased and poverty eliminated. The International Development Strategy targets for per capita income growth in developing countries of 4.4 per cent in the 1980s and 4.7 per cent in the 1990s would require an increase in the investment to gross domestic product (GDP) ratio which would seem well within the reach of all developing countries, except those with the lowest incomes (part Two, IV, B).

Ramana (part Two, III, A), on the other hand, points out that total investment would have to be on the order of 18 per cent of gross world product (GWP) in order to accommodate a projected 2 per cent average annual rate of increase in the labour force. Furthermore, he observes that to transform human numbers into productive human capital would require an additional investment of at least 12 per cent of GWP. Also, an extra 10 per cent would have to be added to provide capital improvement and modernization, bringing the total development requirements to 40 per cent of GWP.

Clearly, slowing the rate of population growth would not have an immediate impact on labour force growth and hence, on capital requirements. It is a matter of concern whether over the next several decades, it should be possible to accumulate sufficient physical capital to provide productive employment for projected levels of labour force growth.

To foster employment, developing countries should pay particular attention to those policies that create employment opportunities outside the



agricultural sector. In particular, emphasis should be placed on the creation of non-agricultural employment opportunities and agricultural support services in rural areas. Though developing countries should employ labour-intensive production processes wherever feasible, international policies should be pursued that will enable these countries to acquire the necessary capital goods and that will facilitate the transfer of technology. Finally, developed countries should adopt policies that will limit or eliminate protectionist trade policies, so that export markets for industrial products manufactured in developing countries can be secured.

Social security. Though they were primarily concerned with the youthful age structures of developing countries, the framers of the World Population Plan of Action were not silent on the question of meeting increased social security requirements in nations whose populations were aging as a result of declines in fertility. The Plan of Action urges countries to consider the implications of the combination of aging populations with moderate or low fertility and suggests that countries carry out, as part of their development programmes, comprehensive, humanitarian and just programmes of social security for the elderly.49/

In the paper presented by the Centre for Social Development and Humanitarian Affairs of the Department of International Economic and Social Affairs, United Nations Secretariat, (part Two, IV, G) it is pointed out that there will continue to be an increase over the next four decades in the absolute and relative size of the aging populations in all regions of the world. However, this issue is of particular concern to the developed countries where, in 1980, about 17 per cent of the total population was aged 65 or older. By the year 2000, this figure should grow to 20 per cent, and by 2025, it should exceed one fourth of the total population of these regions.50/

It should not be forgotten, however, that slightly over half of all persons over 60 years of age now reside in the developing countries, and it is projected that this proportion will reach 72 per cent by the year 2025.51/ But relative to the size of the working age population, it is primarily the developed countries that will face the heaviest burdens in providing a decent standard of living for the elderly in the years to come.

In the medium term, the paper of the Centre for Social Development and Humanitarian Affairs observes that the aging of populations in the developing countries may have a beneficial effect because the proportion of persons in the economically active ages increases with the drop in the rate of population growth. However, it also points out that as development proceeds, entry into the labour force may be delayed in order that young people may get more schooling and retirement at an early age may become increasingly prevalent.

In most developed countries, income and health care for the elderly are increasingly provided through social security systems.52/ Thus, the cost of supporting that portion of the population becomes a function of demographic factors and public policy. Given constant levels of benefits and a declining proportion of persons of working age, financing social security would require continued growth in worker productivity or increased tax rates on the incomes of the employed. The higher the quality of medical care and the greater the



level of income support provided for the elderly, the more significant these requirements will be.

The cost of supporting the very old is likely to increase with further declines in mortality rates at higher ages and with the advancement of increasingly expensive medical care. This problem may be particularly acute in the ECE region where the aging process has been associated with a significant rise in the proportion of the very old (75 years and over). Between 1950 and 1980, the size of this group grew by 127 per cent as compared to a 64 per cent increase in those between 60 and 74 years of age.

As populations age, it may become increasingly important to consider the long-term costs and benefits of retirement plans. The contribution by the Centre for Social Development and Humanitarian Affairs points out that the expected continuation of the aging process would require even greater financial support in the future. It appears that the cost of social security programmes can be reduced only by lowering benefits or reducing the number of beneficiaries.

In addition to the problems of meeting the increased cost of social security programmes, the aging of populations may have significant impacts on investment and consumption, though the impact on the latter, and therefore on savings, is clouded by conflicting empirical and theoretical evidence. But on balance, the increasing number of older workers should not adversely affect productivity in the developed countries. The paper prepared by the ECE provides a thorough analysis of the impact of the aging of population in a developed region.

Income distribution. Although the World Population Plan of Action suggests that the promotion of social justice and a more equitable distribution of income, land and social services could serve to moderate fertility levels,<sup>53/</sup> it stresses as one of its fundamental principles the need to ensure that the underprivileged of the world shall achieve, through structural, social and economic reforms, a significant improvement in their living conditions.<sup>54/</sup> The reduction of inequality both between and within nations is also a principal objective of the International Development Strategy for the Third United Nations Development Decade, which states that "accelerated development calls for a more equitable distribution of economic opportunities among nations"<sup>55/</sup> and that "accelerated growth in developing countries is also needed in order to support national policies aimed at achieving a more equitable distribution of income and benefits from development".<sup>56/</sup>

Although population growth rates have been moderating over the last decade, trends in the distribution of income indicate only moderate declines in the incidence of poverty. According to Mangahas, the World Bank gauged the incidence of poverty in developing countries at 37 per cent in 1975 and at 33 per cent in 1980. And although the rate of poverty has declined slightly, the number of absolutely poor has increased because of population growth.

Closely associated with disparities in income are disparities in land ownership and particularly the increasing incidence of landlessness. Eckholm



notes that "rapid population growth, the scarcity of unexploited arable lands and rising economic inequality all appear to be contributing to the worldwide increase in the number of landless and near landless people".<sup>57/</sup>

It has often been observed that the relationship between income distribution and population change is far from simple and direct. In part, this may reflect the fact that the two variables interact upon one another.

The paper prepared by UNCTAD points out that demographic factors have very direct implications for the disparities between the developed and developing regions. In particular, the fact that population growth rates in the two regions are quite different implies that in order to reduce or even stabilize the income gap, the rate of growth of GDP must be substantially greater in the developing countries than in the developed.

In the paper prepared for the ILO (part Two, IV, D) Gerry Rodgers sets forth a number of hypotheses as to why population growth might lead to increasing inequality. For example, (a) it increases the supply of labour relative to land; (b) the division of holdings lead to small farm sizes which are not viable; (c) population growth is often more rapid among lower income groups whose share of total income may be fixed; (d) fixed government budgets for services to the poor may provide less per capita; and (e) high fertility and dependency make it difficult for the poor to invest in health and education for their children.

Rodgers finds both from a review of the literature and from running a fully recursive model in which both population growth and inequality are treated endogenously, that when population growth is the dependent variable "the inequality measure is statistically weakest among the explanatory variables" and when inequality is the dependent variable, population growth turns out to be statistically insignificant. Even more surprising is his finding that "with growth in GNP per capita as the dependent variable, current population growth is totally insignificant and has a positive sign, quite contrary to conventional wisdom". Rodgers concludes by suggesting that "future research in this area will perhaps be most productive if it concentrates not on direct relationships between population growth and inequality but on the multiple roles of population growth in the transformation of systems of production. It is surely these transformations which are the key to understanding changes in inequality. These changes can then be traced in part, and indirectly, to population growth".

For example, the paper prepared by the Economic Commission for Latin America and Caribbean (ECLAC) (part Two, IV, C) stresses the need to address the problem of poverty and the inequitable distribution of wealth and income by adopting more appropriate styles of development and styles of life.

In view of the scarcity of concrete evidence linking rates of population growth to inequality, it is questionable whether population growth policies should be formed in regard to promoting equity and social justice. However, there does appear to be considerable reason to believe that policies relating to internal and international migration may have strong implications for the distribution of welfare within and between nations and that the findings of



the Expert Group Meeting on Population Distribution, Migration and Development (United Nations publication, Sales No. E.84.XIII.3) should be considered carefully with these implications in mind.

### Resources and the environment

In assessing the interrelationships between population, resources and the environment, the environment is viewed as both a source of natural resources and a repository for the wastes generated by consumption and production processes. In other words, natural resources are treated as being part of the environment.

As requirements for natural resources increase both with growing populations and growing per capita consumption, the World Population Plan of Action calls for consideration of the supplies of natural resources in planning population policies, and directs attention to the need for a just distribution of resources and to the minimization of wasteful aspects of their use throughout the world.<sup>58/</sup> In particular the Plan of Action states that it is imperative that all countries, and within them all social sectors, should adapt themselves to a more rational utilization of natural resources.<sup>59/</sup>

The need to husband our resource base is also set forth in the International Development Strategy for the Third United Nations Development Decade which states that "the rational development, management and utilization of natural resources should be encouraged in order, inter alia, to prevent early exhaustion of finite resources and over-burdening of renewable sources of energy".<sup>60/</sup>

With regard to the environment, the World Population Plan of Action calls for consideration of the quality of the environment in developing national population policies and goals.<sup>61/</sup> In particular, it recommends that Governments should take into account not only short-term economic returns but also the social and environmental costs and benefits in planning development.<sup>62/</sup>

The need to avoid environmental degradation is also mentioned in the International Development Strategy when it states that "there is need to ensure an economic development process which is environmentally sustainable over the long-run and which protects the ecological balance. Determined efforts must be made to prevent deforestation, erosion, soil degradation and desertification".<sup>63/</sup>

This section is particularly concerned with mineral resources, the land-resource base, and the effect of waste disposal on the resource base.

### Minerals

With the exception of oil, the supply of most mineral resources does not appear to impose significant constraints on present or anticipated future growth, although the real cost of certain minerals is likely to rise. And, in



examining likely future supplies and demands for key minerals the UNIDO study found that, if technology permits resources to be converted into reserves, they should be sufficient to meet demands up to 2025.

The unprecedented growth of the world economy during the period between 1950 and 1973 was fueled mainly by the availability of inexpensive petroleum. During that period annual world production per capita increased from 1.5 barrels to 5.3 barrels.<sup>64/</sup> Since that time, the quadrupling of oil prices has reduced world rates of growth in oil consumption and has focused the world's attention on the energy problem. Today a great deal of uncertainty exists as to whether present consumption trends will continue.

A number of long-run projections of oil production and demand have been made which have led to the general conclusion that potential oil demand in the year 2000 is unlikely to be satisfied by crude oil from conventional sources. No census has developed with respect to natural gas resources. But it has been estimated that at current rates of production, reserves would last about 45 years. At the 1976 rate of consumption coal reserves are projected to last over 200 years. With regard to uranium resources, it is estimated that they are comparable in their energy-producing potential to the remaining recoverable resources of oil and gas.<sup>65/</sup> But substitution of coal and nuclear power for oil poses major environmental problems, and ultimately there must be a transition to renewable energy sources.<sup>66/</sup> It should be noted, however, that use of the latter may also pose environmental hazards.<sup>67/</sup>

The UNIDO scenario concludes that given current trends in energy consumption and additional demands originating from the industrialization of the developing countries, there must be a transition to new patterns of energy demand and supply. This transition would partly become feasible as alternative technologies became economical and conservation became widespread in response to rises in the prices of fossil fuels.

It should be noted that resource scarcities can result also from a concentration of their ownership. In particular, many of the major deposits of mineral resources located in developing countries are owned by large transnational corporations. Closely related to this is the ownership of technology. Since productive use of natural resources depends to a large degree on the application of available technology, policies to reduce the degree of concentration in the ownership of natural resources and to eliminate barriers to the wide dissemination of technology would tend to ameliorate potential scarcities of natural resources, including mineral fuels.

These policies should deal not only with the distribution of resources and the transfer of technology but should also address the question of wasteful uses of resources.<sup>68/</sup> In the past, decisions regarding natural resource exploitation have been strongly influenced by short time-horizons and high private discount rates, both of which lead to a more rapid exhaustion of the natural resource base. Thus, resources may be conserved if longer time-horizons and a social discount rate were used in planning. Along with this, the adoption of life-styles that are compatible with more conservation-oriented styles of development would contribute significantly to relieving resource scarcities.



Overcoming these economic, social and institutional constraints should do much to relieve pressure on scarce resources, but this will require effective political leadership and a considerable period of time. Slowing rates of population growth may provide planners, policy-makers and political leaders with the additional time they need to make these difficult adjustments.

#### Land-resource base

Both because of its relation to meeting food requirements and its provision of employment and family security, land constitutes the key renewable resource, the supply of which depends critically on environmental factors.

Estimates of the world's potentially arable land indicate that roughly half of this total is currently under cultivation. The margin of reserves is very narrow in Asia, but in all regions there are some countries with very low arable land reserves. According to an FAO study involving 90 developing countries, 46 per cent of the population lived in those countries where arable land margins were already the lowest. This finding raises serious questions about the feasibility of increasing food production through the expansion of cultivated areas.<sup>69/</sup> It is expected that the expansion of arable land will slow to less than half the rate of increase that prevailed over the last two and a half decades. As a result, the amount of arable hectares per capita in the industrialized market economies is projected to decrease from .55 in 1975 to .46 in 2000. In the developing countries (not including China), it is projected to fall from .35 in 1975 to .19 in 2000.<sup>70/</sup>

Clearly the food requirements of a growing world population will have to be met largely by increasing use of already cultivated land, by increasing yields and by multiple cropping. Even where it is possible to expand arable land it is often the case that returns to intensification will exceed returns to developing remaining land resources.<sup>71/</sup>

The distribution of land ownership is also an important factor in affecting the availability of arable land for food production.<sup>72/</sup> Concentration of large land holdings in the hands of a few individuals puts substantial pressure on the remaining land. Those who do not join the ranks of the landless labourers are forced to farm increasingly small plots of land from which it becomes increasingly difficult to produce sufficient food. Furthermore, very large farms tend to be less productive than small farms.

Even as arable land is being expanded and the amount of gross cropped hectares is being increased through multiple cropping, the stock of arable land is being depleted by land-use conversion for urbanization and by environmental degradation, in particular by the processes of desertification, deforestation, salinization and waterlogging.

It has been estimated that desertification,<sup>73/</sup> if unchecked, would transform into desert an additional area twice as large as the current desert area of 792 million hectares by the year 2000. Since the primary cause for desertification is over-grazing, most of the losses would be from pastures,



although some crop land would be affected. In Africa deserts are encroaching on useful agricultural land at the rate of 60,000 to 70,000 square kilometres a year.

The role of population growth in conjunction with increases in the livestock population is described by Ramana. In particular, he notes that the result of the six-fold increase in the population of North Africa since the beginning of the century has been the loss of more than 250,000 acres of farm land to the desert each year. In the words of Kassas, "desertification arises through a breakdown in the relationship between man and the land". He notes that over the last 50 years this relationship has been upset because of population pressure.74/

Deforestation is expected to continue at a rate of 18 to 20 million hectares per year through the year 2000. In the humid tropics it is estimated that 446 million hectares of closed forest will be lost, which means a reduction of the portion of the earth's surface covered with closed forests from one fifth to one sixth of the total.75/

Reduction of forests would remove their beneficial effects. Among the most important of these effects are preventing soil erosion, regulating water flows (thereby preventing flood and avoiding siltation of dams and reservoirs), absorbing carbon dioxide from the atmosphere and moderating local climate. Furthermore, forests and particularly those located in humid tropics provide habitats for millions of species. With continued deforestation some 20 per cent of all existing species may become extinct by the year 2000.

The number of species has been estimated at somewhere between 5 and 10 million, of which 1.6 million have been identified. About 63 per cent of these occur in the moist forests of the tropics where many of them live in small populations in generally localized environments which makes them vulnerable to intrusions.76/ Marshlands, tidal flats and other wetlands also contain many species which are endangered by economic activities. Myers considers it likely that during the last quarter of this century a total of one million species will be lost, as deforestation, drainage and dredging and other activities will irreversibly affect their habitats.77/

Deforestation takes many forms and has many causes. In part, forests are felled to provide pasture to meet demands for beef and timber in the developed countries. But perhaps more important in the loss of forest is the poor in developing countries struggle to meet their basic needs. In particular the consumption of fuel wood is a major contributor to deforestation in developing countries.78/ In 1977 FAO estimated that there would be a 2.2 per cent annual increase in demand for fuel wood in developing countries and predicted that in 1994 there would be a fuel wood shortage of 650 billion cubic metres annually in wood-poor countries.79/ And, Ramana estimates that the consumption of fuel wood will increase by about 70 per cent by the year 2000 simply as a function of population growth.

Closely related to the issue of deforestation is the practice of shifting cultivation. It is projected that the number of people engaged in this type of cultivation will increase by 50 to 70 per cent by the year 2000. The



result will be increased use of marginal lands with attendant risks of steep slope erosion, increased flooding and siltation and loss of land productivity.

When multiple cropping is proposed as a means of increasing total cropped area, it should be borne in mind that this normally requires irrigation, and at present it is estimated that about half of all the irrigated lands of the world have been damaged by salinization, alkalinization and water logging.<sup>80/</sup>

Much of the environmental degradation of land resources associated with desertification and deforestation can be traced to population growth and poverty in the context of the common property resource problem.<sup>81/</sup> That is, common property resources are free goods for the individual and scarce goods for the society.

Thus, in the Sudano-Sahelian region of Africa, cattle are individually owned but grazing is not. With increasing herds, over-grazing has occurred with a consequent increasing scarcity of the common property resource. The land having been stripped of vegetation, shifting sand dunes are being formed, thus further rendering useless the remaining productive areas.

Deforestation of the Himalayan foothills also illustrates the interaction of population growth, poverty and the excessive exploitation of a common property resource. Since their incomes are too low to purchase commercial sources of energy, most people in the area rely on firewood. The resulting loss of vegetation cover has caused topsoil to be washed away, thereby causing diminished retention of water, siltation of the rivers, landslides and thus a loss of soils and water not only in the Himalayan foothills but also in areas downstream. And the process is cumulative, leading to further pressure on not yet exploited forest lands.

Protecting the agricultural base in developing countries from further environmental degradation will require measures to alleviate poverty and to develop social institutions for managing common property.

Since most of the environmental degradation of land resources is caused by improper agricultural practices, policies should be pursued that contribute to changing those practices to ones better adapted to local environmental situations. Examples of such practices would be the encouragement of soil conservation through contour farming, terracing, the use of animal wastes, inter-cropping and integrated pest management. Policies to promote these practices would include agricultural extension and raising awareness of environmental problems.

### Waste disposal

The problem of a reduced agricultural land base through the effects of desertification, deforestation and other factors largely flows from the excessive and improper use of common property resources. There is also a form of environmental degradation resulting from excessive use of the environment as a reservoir for the wastes generated by production and consumption activities. Depending on the volume of this waste and the absorptive and



regenerative capacities of the environment, these practices can also undermine the resource base and productivity in many ways.

The most commonly cited examples of environmental problems arising out of waste disposal are air and water pollution. Air pollution takes many forms: oxides of nitrogen and sulphur, particulates and chlorofluoromethanes to name but a few. A problem that has been a source of concern for some time is the buildup of carbon dioxide in the atmosphere as a result of the burning of fossil fuels to meet the energy requirements of a growing world population at an increasing standard of living.<sup>82/</sup> The paper prepared by the World Meteorological Organization (WMO) (IESA/P/ICP.1984/EG.III/20) points out that steady increases in carbon dioxide have the potential of having far-reaching effects on climate. The paper spells out the serious consequences which might be expected to result if a projected doubling of the carbon dioxide in the air were to raise the average global temperature by even a few degrees. It also calls attention to the serious problems associated with the release of chlorofluoromethanes into the atmosphere, indicating that this problem may have effects equal to at least half of the effects associated with carbon dioxide. It should be noted that these chemicals in the atmosphere also pose a danger to health by depletion of the ozone layer, a protective barrier against excessive ultraviolet radiation.<sup>83/</sup>

These forms of environmental degradation are usually associated with affluence, particularly the widespread use of automobiles. Nevertheless many urban areas in developing countries are presently experiencing air pollution problems which had until recently been largely associated with urban areas of developed countries.

Linking the problems of air and water pollution is the phenomenon of acid rain.<sup>84/</sup> Oxides of sulphur and nitrogen through chemical reactions in the atmosphere form acids which can precipitate far from their place of origin as acid rain. A buildup of acid levels has destroyed the fish population of lakes and in addition acid rain causes a decrease in the useful life of buildings and other structures.<sup>85/</sup>

Water pollution takes two major forms. That which is the result of most industrial processes and municipal waste disposal is termed "point water pollution". Non-point water pollution is usually generated by agricultural production processes, and often it is this form of water pollution that is most difficult to combat.

Pollution of the waters as a result of industrial production takes a variety of forms, among the most important of which are the discharge of toxic chemicals and thermal pollution. As water increases in temperature the amount of dissolved oxygen necessary for aquatic life is diminished.

As noted in an earlier section, meeting the food requirements of a growing world population will require rapid agricultural modernization, and this is particularly true if countries aim at achieving self-sufficiency in food production. In general this modernization will involve increased use of fertilizers, pesticides and herbicides, often in combination with increased irrigation. The run-off of these chemicals may lead to surface water



eutrophication and to the introduction of poisonous chemicals into the water, where they enter the food chain.<sup>86/</sup>

The role of population growth in this situation is relatively clear. Given current material aspirations, modes of production and waste disposal practices, providing for larger populations increases the amount of waste that must be deposited in the air and waters. Thus, current high rates of population growth must be considered a contributing factor to the intensity of these problems. However, a great deal of room remains for reducing levels of air and water pollution through non-demographic policies, particularly changing modes of production and consumption. As Ignacy Sachs points out, the problem "boils down to finding another development style and pursuing growth in a socially equitable, economically viable and ecologically sustainable way".<sup>87/</sup> In many cases it is necessary for the Government to take policy measures that would internalize the costs of what many producers and consumers now consider to be externalities. Government regulation is often necessary because the costs of abating environmental degradation are borne by the individual, while the benefits of such abatement are shared by society as a whole. Thus, policy measures must be implemented at a national level which no producer can escape and thus enjoy a competitive advantage.

In this regard it should be noted that a number of problems of pollution of the air and water transcend national boundaries, and individual nations may hesitate to adopt policies unilaterally to abate certain forms of environmental degradation because in so doing they would place their national economy at a competitive disadvantage with nations that refrain from adopting pollution abatement policies. Closely related to this is the fact that transnational corporations are often in a position to shift production processes to areas where they may be able to avoid the costs of abating the air and water pollution they create.

Policies designed to eliminate non-point pollution will be more difficult to frame and implement. Since it takes place at many points, monitoring of compliance with official standards will be much more difficult. Second, such pollutant practices are the result of the combination of poverty and population growth in rural areas. Without elimination of poverty and without creating employment opportunities for the growing rural populations of developing countries, it will be most difficult to avoid further pollution of the waters in the course of agricultural modernization.

It may be expected that the non-demographic policies that have been described here will meet with stiff opposition. Regulations will be opposed by those who can now pass environmental costs on to others. Attempts to change the way commonly owned resources are managed will meet with cultural, political and institutional obstacles. Often it will be difficult to mobilize the public support needed to adopt and implement these policies. Slowing rates of population growth should provide the national leadership with more time to accomplish these most difficult tasks. Population policy may not be a necessary or sufficient condition for solving environmental problems. Rather population policy should be viewed as a complementary element, giving individuals, communities and nations additional time to find and apply more fundamental solutions to these problems.



### Integrated planning

The World Population Plan of Action stressed the interrelatedness of population and development, and urged integration of population policies into socio-economic development plans and the creation of organizational structures suitable for the task. As a result, the Plan of Action has brought about a growing recognition of the importance of treating population, development and their interrelationships jointly in the planning process.

Approaching the same issue from the vantage point of development viewed as an integrated process of change, the International Development Strategy for the Third United Nations Development Decade stipulated that national development plans should be formulated on the basis of a unified approach and should take into account not only immediate but also long-term social and economic objectives. Furthermore, in the process of development the interrelationships between development, environment, population and resources must be taken into account.

In line with the directives of the World Population Plan of Action, the contribution of the United Nations Department of Technical Co-operation for Development and ILO (IESA/P/ICP.1984/EG.III/12) points out that the former, with the support of the United Nations Fund for Population Activities, has assisted a number of countries in their efforts to make the institutional arrangements and to carry out activities facilitating integration of population considerations into the development planning. Consequently, population units have been set up in planning offices or related organizations in a number of developing countries. The units have been entrusted with the training of the national staff, the monitoring and analysis of population trends, the study of socio-economic and demographic interrelationships, population-policy-oriented research, and with the integration of population variables and policies into the development plans and/or drafting of the population plans.

Other endeavours in this field have focused on the integration of population variables in planning for selected areas, as is pointed out in the ILO contribution. Examples of these include technical co-operation projects in a number of developing countries, the objective of which has been "the incorporation of demographic elements into human resource development and employment-related development policies, and more broadly to facilitate the integration of population issues into national development planning", for example, by the development of long-term simulation models.

In spite of various efforts at integrating population variables and policies into development planning over the last decade, this integration is still in its inception. Herrera's call, in 1973, for the design of normative models which seek solutions to contemporary problems by exploring "all possible degrees of freedom in the complex mankind-resources-environment relationship" has not been satisfactorily answered.<sup>88/</sup> The paper prepared by the United Nations Environment Programme (UNEP) (IESA/P/ICP.1984/EG.III/14) for the Expert Group Meeting indicates that a conceptual framework, based on a "system approach" applicable at regional and national - rather than global -



levels, must yet be developed and that techniques of optimizing the whole interactive system must be part of it. The contribution of the Economic and Social Commission for Asia and the Pacific (ESCAP) (part two, II, C) cites Gavin Jones' review of the situation in Asia, in which he concludes that "there is a long way to go before population is fully integrated into development planning in the region if full integration is taken to mean that effects of economic policies on population trends (and vice versa) are given close consideration". The progress made so far has been probably greater in connection with the development of the institutional framework for integration. This has been hindered, however, by the same factors encountered in 1974: inadequate understanding of the population-development interrelationships, limitations in the existing planning methodology, and lack of local expertise in this area. It is also possible that the existing planning structures and approaches had acquired rigidities which preclude taking into account the needs of population planning and the importance of considering population variables.

The importance of approaching the task of planning as a unified one must, therefore, be stressed again. Ramana points out that this approach would comprise discussions that are essential for the solution of the problem of underdevelopment, such as changes in the composition of output and income to benefit the low income groups, utilization of methods of production that make use of local resources, the provision of social services and the creation of community assets that raise the productivity of labour.

Mangahas also recognizes that some elements have been sorely lacking and need to be addressed. These include (a) reclassifying additions to basic education, health and housing as investments; and (b) measurement of activities that increase the welfare of target groups so that these measurements can be incorporated into the target setting, project appraisal, monitoring and evaluation activities which are the components of the planning process.

The relatively small accomplishments realized this far, the demands of integrated planning as stressed by Ramana, and the reorientation of development management towards distributive equity emphasized by Mangahas all point to the need for intensified efforts directed at strengthening the institutional arrangements for the integration of population in development planning. At the same time, further development of data sources and research capabilities required for an improved understanding of the interrelationships between economic, social and demographic, and other relevant variables must be stressed. It is equally important that planners consider applying in the planning process the emerging techniques that facilitate the integration of population variables in development planning. Last, but not least, it is important that they modify their planning processes to make them more receptive to the introduction of population variables and policies.



### Conclusion

During the 10 years that have elapsed since the 1974 World Population Conference a number of international conferences and symposia have dealt in one way or another with the interrelationships between population, resources, environment and development. And though our knowledge and awareness of the problems derived from the interrelationships has increased, we are far from a satisfactory understanding of the interrelationships themselves. This is mainly because we have not yet reached the situation in which we can actually trace the causalities between the many variables that are involved. The interactions between the variables are exceedingly complex and diverse, and the deeper we delve into these interactions the more difficult it becomes to keep track of all the repercussions following from them. And even if we stop short of attempting to trace the causalities, we still have only a limited knowledge of the linkages between the various factors.

The interrelationships between population, resources, environment and development form a seamless web, the boundaries of which we only dimly perceive. Still sorely lacking are a proper conceptual framework and most of the fundamental data. The absence of these explains to some extent why we still have very little knowledge of how, for example, population responds to changes in the environment.

Although it may appear that the problems resulting from the interrelationships in general, and from environmental change in particular, are only of a recent date, they are in fact as old as mankind. But what makes them of a different nature today is that their dimension has increased to such a degree that they operate and exist at the global level. Environmental problems are no longer localized even though they may be locally created. For instance, the buildup of carbon dioxide in the atmosphere can have global climatic consequences which may affect the lives of many future generations.

This last example indicates that, besides the global importance of the interrelationships, there is also the importance of the time factor. Although it appears that the interrelationships between population, resources, environment and development reveal their full importance particularly in the long run, this does not mean that they are absent in the short- to medium-term. But because of the synergistic character of the interrelationships their effects are not as noticeable in the short run, which poses the danger of complacency by the present generation vis-à-vis the problems resulting from the interrelationships. Neglect by those who live today can have severe consequences for future generations. The longer we delay the necessary counter measures the more difficult it will be more to find effective solutions to the problem.

In applying such solutions we are in need of a unified approach to the study of the interrelationships. That is, a sectoral approach is not enough and in fact is meaningless, because a solution that is limited to only a single sector does not take into account possible harmful effects in other parts of the system. This does not mean that each factor cannot cause direct and independent effects, but there is a larger dimension which can only be



dealt with in a systems approach where the linkages between the variables are of more importance than the variables themselves. To achieve this systems approach, interdisciplinary research in the area of interrelationships which goes beyond the fields of demography, economics and ecology has to be pursued, because it is ultimately the combined effect of population, resources and environment that is of crucial importance.

Although the role of population within the interrelationships is still poorly understood, it can nevertheless be affirmed that, at least in the developing countries, population growth and the maldistribution of population with respect to resources aggravate the problems resulting from the interrelationships. Lowering the rate of growth of population might give us time, thereby enabling us to use a wider range of options for finding solutions. The main difficulty remains, however, the demographic inertia which is built into the population age and sex structure. It is in this respect that problems faced by the developing countries are so much more difficult to resolve than those with which the developed countries have to contend. While in the developing countries the combined effect of all four factors points to a series of particular problems, in the developed countries this combined effect is of a different nature. Furthermore, many developing countries suffer from unfavourable natural conditions such as an erratic climate and poor quality soils which add an extra dimension to their problems. Last, but not least, the financial means to take measures which can (a) protect the environment, (b) contribute to a more rational use of natural resources and (c) lead to the adoption of more conservation and substitution-oriented technologies are not available in the developing countries to the extent that they are in the developed countries.

As much as it was possible for the environmental movement of concerned citizens to form a catalyst in raising the consciousness with regard to environmental degradation, the irrational use of resources and existing life-styles in developed countries, it should be possible to use the force of families and village communities in developing countries to deal with the problems resulting from the interrelationships between population, resources, environment and development. In fact, while in many modern societies the sense of community has almost disappeared, it still is very much present in the more traditional societies. This communal spirit presents a source of strength in tackling the problems of insufficient resources and environmental degradation at the local level and therefore ultimately also at the global level.

The reliance on grass-roots involvement in finding appropriate solutions shows clearly that social, cultural, institutional and political factors have to be integrated into the study of interrelationships because these factors in particular determine, and therefore also can change, life-styles. And, it appears that it is in the change of life-styles that we have to find the solutions to the problems of the interrelationships between population, resources, environment and development.



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B. Impact of trends in resources, environment and  
development on demographic prospects

Nathan Keyfitz\*

In order to arrange the large volume of material that falls under the title of this paper, it will be useful to start with a simple model and then show how the model must be extended step by step to deal with the varied conditions that can be expected to prevail in the complex real world of the years 1980-2030. First, a methodological question is posed on the usefulness of the environmental impact discussed here for population projection.

Resource determined or extrapolated population

The customary way of projecting population is to examine the series of births, deaths and migration separately, and to use past time series to judge what future births, deaths and migration might be. Sometimes the projection is made by fitting curves to past series, sometimes by using serial correlations, but most often it is made by judging what the long-term trends are likely to be. For example, the United States Bureau of the Census projects one of its current series by assuming that the long-term number of children born per couple will be 1.9.1/ If data other than the birth series enter, it is implicitly; one finds in the report describing the projection no reference to availability of jobs, to capital growth, to food resources, to technical innovation, or to other elements on which the population and birth numbers will plainly depend. A projection that takes no account of elements outside of the numbers of the same series in the past is a species of extrapolation, though it should be borne in mind that extrapolation can include some highly sophisticated procedures, and that in the mind of the person doing the extrapolation, and choosing among procedures, there may well be considerations far beyond population, even when they are not explicitly stated.

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\* Professor, Department of Sociology, Harvard University, Cambridge, Massachusetts.



The opposite of extrapolation is projection based on a model that does take into account other variables than population, in which the population variable may be thought of as dependent. By a guess, or some more systematic procedure, one might assess the resources that seem to be available in a country, extractable at some assumed level of technology. If one thus found the population-sustaining capacity 50 years from now, and hence the population 50 years from now, one could simply interpolate the intermediate figures, the path through which the population gets from here to there. Some elements of this approach are to be found in Frejka.<sup>2/</sup> In so far as the population is resource-determined, a possibility that will be discussed at some length below, this could well give results superior to those of extrapolation. This might be called the population-capacity approach.

The extrapolatory and capacity approaches can of course be used together. A reasonable procedure would be to extrapolate, to consider whether the numbers extrapolated for the year 2030 seem consistent with what one knows about carrying capacity, and to modify the extrapolation, by choosing some other formula, to make the outcome consistent with the resources presumably available. Thus the World Bank, by a method that we can suppose extrapolatory, finds an ultimate population of 435 million for Nigeria, which would then be the third largest country in the world.<sup>3/</sup> An assessment of the milieu might well lead to a downward adjustment of this figure.

This paper goes far beyond projection or forecasting; it tries to find in what degree population (and its components of birth, death and migration) is resource-determined. But here, as in many other parts of demography, the attempt to forecast is a stimulus to realistic thought about the way populations grow. Many a theory is proven false by the failure of predictions based on it. That way of testing takes too long for us to use here, but we can substitute thought experiments, based on past experience, that will help illuminate the influence that environment and resources exercise on population.

### The basic, primitive model

The classic representation of the relation of population to the resource base on which it sits can be stated in three words: resources determine population. The primal resource is food, and another way of expressing the classic position is that population climbs up to the level permitted by its food base. Everything else -- and in particular, technology -- is implicitly supposed unchanging. This notion of carrying capacity goes back to early thinking about population, and many authors could be quoted. A modern biologist expresses the view, quoting some ancient sources: "In 1588, Giovanni Botero suggested that human populations did not grow, because the environmental resources were insufficient to support a larger population. Sir Walter Raleigh in 1650 noted that although Spain sent large numbers of men to war the size of the country's population remained stationary. This he attributed to the fact that Spain's population was adjusted to what the country could nourish".<sup>4/</sup>,<sup>5/</sup> Some of Malthus's early writing, especially the first essay, expresses this view, though later editions are much more nuancée.<sup>6/</sup>



The only way that resources or any other variable can influence population is through the components of population growth: births, deaths and migration. On this primitive model, if the population exceeds its resource base (including in an obvious extension non-food resources that it can exchange for food) death rates will rise, either directly through starvation, or else, and much more commonly, through malnutrition making people susceptible to disease. Both the direct and indirect effects of food shortage are likely to show most conspicuously in infants and young children. If people anticipate the shortage they can restrict births and so avert the larger damages of malnutrition for themselves and their children; in that sense births are more or less consciously adjusted to resources. Finally, if the shortage of resources is purely local, people can move to some other place where resources are more plentiful; thus migration is a means of adjusting local populations to resources.

This kind of analysis conceives of man as essentially inert, responding to changes in resources, but initiating nothing. The best way to see the limitations of this viewpoint is to think of the species of beings to which it does apply.

With non-human creatures the notion of population responding demographically to resources is not unrealistic. One starves out the population of stray cats by seeing to it that there is no food lying about. Birds that have a territorial instinct keep their numbers proportional to the sustaining capacity of the terrain by preventing any that do not have a nesting place from breeding.<sup>7/</sup> All species migrate shorter or longer distances in search of food and so tend to spread over the landscape in proportion to the availability of supplies. Explaining rates of death, birth and migration among animal species as it does, this model is useful in the study of animal and plant population, and our quotation from Smith above is typical of standard biology textbooks.<sup>8/</sup>

But biology is much more sophisticated than this implies. It sees everywhere multiple trophic levels, at each of which subsist the number of creatures permitted by food supplies at the next lower level. At the bottom of the food pyramid are plants that directly convert the energy of the sun; just above them are herbivores that eat the grass or grain or fruit, and so on upwards. Because the energy loss at each level is great -- two thirds for even the most efficient converters, and often as high as nine tenths -- the number of levels is small. At least on land, more than three or four levels are rare. In the oceans the primary converters are microscopic creatures, and more intermediaries have a place between algae and whales than between the grass of the African plains and the lions who are ultimately dependent on it.

As Berrill put it: "Herbivores extract only 50 per cent of the calories present in plant protoplasm, and of this only 20 to 30 per cent is built into the animal protoplasm, representing a net efficiency of 10 to 15 per cent. And so with the secondary consumers, the carnivores. At the most, about 70 per cent of the flesh of the herbivore is consumed, yet of this no more than 30 per cent goes into tissue building, so that the maximum efficiency of turning meat into meat is about 20 per cent".<sup>9/,10/</sup>



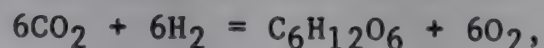
In the real world most creatures have alternatives to such a one-dimensional feeding system. Instead of each species living directly and solely on the one just below, there is an intricate web of life in which the numbers of each are controlled by the numbers at all other levels.<sup>11/</sup> Man has greatly simplified the food chains on which he lives, so that he is limited to such circuits as grain-hogs-man, or grain-cows-man, or just grain-man. The last is what most of mankind depends on most of the time. The discovery of grains -- millet, wheat, corn, rice -- in various parts of the world, and the fact that they constitute a storable form of accessible energy, has probably been the most important single condition for human population growth.

### Life and the flow of energy

In order to see how much room there is for the further expansion of the human population we need a quick survey of the energy flows of which people are a part. The question of more people (the United Nations medium projection gives 6.1 billion by the year 2000, 8.2 billion by 2025), as well as the welfare of the population, is in one aspect reducible to the question of how much more of the existent energy man can channel for his own use.<sup>12/</sup>

An unobstructed square metre of the earth's surface facing the sun at 93 million miles distance collects 1,400 watts of power. Because the surface of a sphere of given radius,  $r$ , is four times the area of its diametrical cross section ( $4\pi r^2$  against  $\pi r^2$ , where  $\pi = 3.14159$ ), a fixed square metre collects one quarter of this amount on the average of its daily and annual cycle around the sun. This is at the top of the atmosphere; about one third (more or less, depending on cloud cover) of the radiant energy is lost in the atmosphere (the city of Boston gets 60 per cent of the energy it would have if the sky were always clear). The net result at ground level, in terms of the common measure of heat, is equivalent to about 3,000 kilocalories (Kcal) per square metre per day.

The visible part of sunlight synthesizes carbohydrates in the presence of chlorophyll, with an equation such as



read from left to right. When the plant burns the carbohydrate, as it must to keep alive while the sun is not shining, the balance shifts to respiration and the equation goes in the reverse direction; heat is produced rather than light absorbed. Photosynthesis creates oxygen, respiration restores the original carbon dioxide. When dead plant matter is buried and prevented from burning, the oxygen is not reclaimed. The fossil fuels under the ground, as well as the indispensable oxygen in the atmosphere, result from the excess of photosynthesis over respiration, continuing over the last billion or more years.

Ordinary plants contain about 4.5 Kcal per gramme of dry weight. An adult weighing 75 kilogrammes needs about 40 Kcal per day per kilogramme of body weight, or about 3,000 Kcal per day, of which at least half goes for maintaining his metabolism. (A small animal or bird requires as much as 1,000 Kcal per kilogramme -- it has to burn more because it has more surface in relation to its mass.)



The human machine gets most of its energy from ingesting cereals. At 4.5 Kcal per gramme,  $3,000/4.5 = 670$  grammes of cereal, or two thirds of a kilogramme, provide the required 3,000 Kcal. If, as demonstrated, 3,000 Kcal is the energy that falls on a square metre of typical earth surface in a day, one square metre ought to provide food for one adult. This in fact falls short of the land needed by about three orders of magnitude.

The production of biomass includes leaves and straw that we cannot eat and seeds that have to save. More important, the most efficient photosynthesis catches only a small fraction of the incident sunlight; plants have to reject the infrared rays if they are to avoid being cooked to death. As little as 1/1000 of incident sunlight is converted to usable biomass, although when conditions are especially favourable (as they are for raising sugar cane in Hawaii or for multiple cropping on well-irrigated lands elsewhere in the tropics) the fraction converted may be as high as 1/25. A fraction of 1/1000 enables the average adult to live on 1,000 square metres, or one tenth of a hectare, and this is the practical limit in most parts of the world that depend on their own foodstuffs.

Variation in primary production is great. Deserts, with less than 10 centimetres of rain per year, cannot produce more than two Kcal of biomass per square metre per day, of which only a fraction is edible. With increasingly fertile lands, and with modern agriculture, the amount rises to 25 and even to 50 Kcal or more per square metre per day. This falls again as we leave dry land, and is down to less than three Kcal in the deep oceans. We cannot exploit the oceans below trophic levels three or four because the creatures are too small. The energy cost of directly gathering plankton (or even up to now Antarctic Krill) is so high that man can afford to do it only through the intermediacy of larger fish.

The argument in terms of the energy flows on which humans depend is encouraging. If we are using only 1/1000 of the incident sunlight, then we should be able to support 10 times present human numbers by discovering how to use 1/100 of the incident sunlight, still a small fraction. And even within present agricultural systems, the United States of America harvests 22.7 tons of potatoes per hectare, India 7.7 tons, and other crops are in about the same ratio; if India could adopt the agricultural techniques of the United States, it could have nearly three times its present harvest. Every inefficiency in present agriculture means that there is room for more people to live better. The whole system seems slack enough to permit the argument that supporting more population requires only a little tightening here and there. Yet such an argument makes the support of population seem deceptively easy. The social constraints on the attainment of biological efficiency will be studied later in this paper.

The relatively simple cycle of sun-grain-man, or sun-grain-cattle-man, displaces the many kinds of cycle that nature left to itself devises. Most are of little economic interest to man, and his activities eliminate them. Nature's richness (thousands of species of forest plants, hundreds of thousands of species of insects) is replaced by a few dozen species of grains, tubers, fruits, vegetables and commercially usable trees. The advantage is great, yet pushed beyond a certain point it creates instability. To quote



Odum: "When ... man is a small part of the overall (ecological) scheme ... he is protected by the great stability, complexity, and staying power of the natural system. For example, the pygmy population within the complex rain forest draws only a small volume from the many channels of fruit and animal products available".<sup>13/</sup> The southward extension of the Sahara is the prime instance of a rich and previously stable condition being altered to a new, and unfortunately much more unstable, condition where humans cannot any longer draw subsistence. Similar changes threaten the delicate ecology of the Amazon.

Study of these elements of the ecology of the human species shows:

(a) That people everywhere, rich or poor, urban or rural, are creatures of the natural environment and ultimately of the sun's energy;

(b) That the low rate of utilization by man, the small fraction of total energy that is skimmed off for maintenance of the human population, suggests that more people could live and live better;

(c) That the shorter the food chain the higher the proportion of incident sunlight available to man;

(d) That increased population increases ecological instability, and buffering against instability, for instance by the maintaining of costly reserves, becomes essential - a point to be further examined below.

#### Effect of population growth on technology

The major defect in the above attempts to relate population directly to land and to energy flow is that they suppose all other factors to remain unchanged. Such another factor is technology. But suppose that the increase of population on the fixed land itself pushes technology, and that in turn makes it possible for a larger population to live on the same land. Clifford Geertz shows how population pressure and irrigated rice agriculture are closely linked in Java. If a circular causal system is operative then the attempt to express population as a pure function of land is entirely frustrated.<sup>14/</sup>

The view that this occurs was given a strong impetus by Emile Durkheim; and the theme has been taken up in our time by Ester Boserup and other writers.<sup>15/,16/</sup> The pressure of population could in principle constitute a challenge and so stimulate invention; after all, the notion of challenge and response was made into an engine of world history by Toynbee.

It is fairer to say that in some circumstances population density impoverishes, in other circumstances it inspires. The southward movement of the Sahara desert makes helpless refugees of the human population at its margins. The challenge of the desert is so overwhelming that no constructive response on the part of the peoples affected is possible. On the other hand, the response of population in the Punjab to the tightness of food supplies has been the adoption of the collection of agricultural practices known as the Green Revolution, and this has multiplied food supplies. Given a challenge



that is severe but not overwhelming, a natural environment that is difficult but not impossible, plus a culture that builds responsiveness into its children in each generation, the inert adjusting of population numbers to food supplies seems to give way to the active adjustment of food supplies to population.

If the mechanism really is operative, so that greater need as such gives rise to improved technology, then we ought to be able to find more contemporary instances where this is occurring. In modern times inventiveness has hardly been most conspicuous in the parts of the world where populations have pressed hardest against subsistence. The better-off farmers of the Punjab have been the first to take up the new varieties and methods developed. The much poorer cattle-tenders of the Sahel have been the helpless victims of periodic drought. Whatever the conditions in the past, the present rule seems to be that better-off people, those whose environment permits them plenty of elbowroom, have the greatest possibilities of innovation. The unfortunate fact is that those people who most need advance because of their poverty are the ones from whom advance is withheld. Nature is like the banker who will only lend money to those who can prove they do not need it.

#### Contrasting models

All our thinking, towards this or any other end, has to be in terms of models, and yet models by themselves give no answers. Nothing can demonstrate their hypothetical character more clearly than the contrast between the biological approach and the demographic transition. A family or a nation has a boost in resources, either of land or of income; will its population increase go up or down? Up, says the biological approach, since population presses against resources, and people have all the children their material condition will permit. Down, says the proponent of the demographic transition, in so far as the rise in income is accompanied by more education and higher aspirations. People realize that many children will hold back their social mobility; in the new kind of (salaried) work that they do to earn the increased income, children are not the help that they were in the days of poverty.

Only empirical observation can tell whether the biological or the transition effect occurs in the real world. Increased income may cause population to increase at first (by preventing some death that would otherwise occur, increasing births by removing traditional constraints, reducing disease-caused sterility), and that later the other effects of higher income (more education, increased security, other and varied personal interests) cause both births and deaths to fall.<sup>17/</sup>

But no unambiguous statement comes out of the observations. Income distribution is clearly important, and sometimes it seems that equality of income is at least as important as income level for the fall in the birth rate; the examples of China and Ceylon, with low but well-distributed incomes, are often cited.<sup>18/</sup> In the context of development - including higher and more equal incomes, universal education, women working outside the home and having their own careers - birth rates do clearly fall.



If at the very lowest levels of income and education the biological model holds, and at higher levels the transition model, then at a certain level there must come a flip. Below it a negative feedback (more income, more population, hence lower income etc.), and we have the familiar stable cycle of over-population and poverty. Above it a cumulative progress (more income, slower population growth, hence more income yet etc.), and the age-old stability is broken. We cannot say that the flip from one relation to the other takes place exactly as \$ 1,000 (or any other number) per person per year is reached, and we know much too little also about the accompanying circumstances.

### The world grain market

What has above been called the simple biological model is qualified in its application to man for many reasons, among them the emergence about the middle of the nineteenth century of a world grain market. The global exchange process that came into existence with steam transport has drastically altered the relation of populations to their ecological bases. The United Kingdom exchanged the products of its workshops for Argentinian and North American grain. Hong Kong's base is in part the wheat fields of the United States midwest. Agricultural specialization has accelerated in recent years. As the official Outlook and Situation of the United States Department of Agriculture puts it: "The developing country markets have been the major growth sector for U. S. Agricultural exports over the past few years. Exports to these areas grew at an annual rate of 22 per cent from 1978 to 1981".19/

No longer does a local famine mean local starvation. In classical Asia an oxcart, fuelled by the grain it carried, could go only a few hundred kilometres before the oxen had eaten all of the grain they started out with. One can imagine 10 carts transferring their contents to five when they had gone part way, then transferring to two, then later to one; the price would have risen more than tenfold. This is a problem in operation research, but however solved in theory, an inland crop failure of more than small radius meant starvation for the people at its center -- there was no practical way to bring relief. Local railways and roads, continuations of the ocean lanes, have changed all this. No one need starve merely because a local territory has suffered a crop failure.

The above reasoning implies a quick end to starvation and malnutrition on the planet. A world grain crop of 1.5 billion tons (1.495 billion for 1982-1983, adding wheat, rice and coarse grains), and 4.6 billion people can provide a more than adequate 325 kilogrammes per year, or 890 grammes per day, for each man, woman and child, and few need more than this. The annual world grain supply has been going up faster than population by about 1 per cent per year, so supplies per person are not only adequate already, but increasing. (We will see how misleading such calculations can be.)

The world grain market has detached individuals from dependence on their local ecological base and has given all of us a common base. If all had the same access to that base, then with low transport costs everyone would now be eating well. That is far from the case.



Access depends on having something to trade for the grain in the world pool. The Union of Soviet Socialist Republics has oil, gold, gas, furs, timber and other natural products; it is expected to buy 15 million tons of wheat in 1982-1983.<sup>20/</sup> China seems likely to import 14.5 million tons, at the sacrifice of a considerable part of its total export earnings. Japan, which regularly imports over 5 million tons, at a cost that is only about 4 per cent of its total exports, becomes nervous at the thought of this (very small) dependence, and has gone to extremes to stimulate its own production of food on tiny plots.

The main point is that we are now in a condition where no one need depend on local food resources, but all can tap the common world supply -- provided they have some other resources, natural or manufactured, with which to trade. If we were to continue the logic of the early part of this article, the populations of the various part of the globe ought to build up in accord with their local raw materials (either directly consumable as food or tradable for food) or else in accord with industrial power. In fact, populations are only loosely correlated with local wealth, natural or man-made.

#### The concentration of world agriculture

The food we eat is only partly a product of current solar input. It is also a product of natural gas and oil formed millions of years ago, applied as fertilizer. Plants have been selected that make efficient use of fertilizers; through this man-directed evolution productivity per agricultural worker in the United States increased by 94 per cent from 1967 to 1980 and multiplied fully threefold from 1950 to 1967.<sup>21/</sup>

In the later 1940s wheat required 5.7 man-hours per acre; in the early 1970s it required only 2.9 man--hours per acre. The output per acre went up from 16.9 to 32.3 bushels. The man-hours per 100 bushels dropped from 34 to 9. (These almost unbelievable figures are due to the capacity of the American farmer to command a supply of fertilizer and other inputs, a command arising from the sheer technological efficiency of his operation.)

Commercial fertilizers applied in the United States more than doubled in amount from 1960 to 1980.<sup>22/</sup> And much energy is used to transport the crops from the fields to the factory, from the factory to the store, from the store to the home. Efficient transport makes it cheaper to concentrate agricultural production on the broad level fields of the Midwest than to grow it closer to the point of use, whether New England or the USSR. Adding transport from the supermarket to the kitchen, plus preparation for the table, we seem now to have reached the point where the input of fossil energy into the food on the table is greater than the output. Our bodies live more off fossil fuels than off current sunlight.

The command of outside energy sources has been such that the food-raising process is now a net energy loser in advanced countries. No preindustrial agricultural could have afforded this; it had at least to produce enough net energy to fuel the agriculturalist and his family, even if no excess was required for non-farm activities.



Accompanying the relocation of agriculture to places where crops can be produced with the least labour has been a rapid increase in the size of farm holding. The farmer producing for his own subsistence has largely disappeared in America, and even the small farmer producing for a local market is of less and less importance. Family agriculture has been succeeded by agribusiness, with an increase in productivity similar to that when artisans were succeeded by factories.

By 1978, 6.6 per cent of farms were over 1,000 acres, and these contained 58 per cent of the land in farms.<sup>23/</sup>

The number of farms of all kinds went down from 5.4 million in 1950 to 2.7 million in 1969; commercial (i.e., specialized) farms went down from 3.7 million in 1950 to 1.7 million in 1969; in particular, poultry farms went from 176,000 to 58,000; fruit farms from 82,000 to 54,000. Consolidation was rapid as farm population moved to the city.

The concentration is not only on larger and larger farms, but also in ownership. The conglomerate Tenneco is a leading citrus producer, and so is Coca-Cola; Dow Chemical is one of the large lettuce growers. The small farmer who ploughs weeds under is no match for the corporation applying herbicides. The efficiency of the more dynamic corporations is unmatched by small operators working for themselves, and leaves governmental agencies far behind.

The territorial concentration of agriculture causes no difficulty within the United States, since transport to carry the product to market is adequate, as is purchasing power to buy it. But territorial concentration in the world as a whole, with a spatial distribution of population very different from the spatial distribution of food output, presents difficulties of transport and especially of purchasing power.

During the expansion of productivity in the United States and other advanced countries the balance of international grain movement shifted drastically. In the 1930s the less developed countries shipped a net of 12 million tons a year to the developed countries; by the beginning of the 1970s the developed countries shipped 46 million tons net to the less developed countries. Where formerly the poor shipped food to the rich and were able to buy manufactured goods with the proceeds, now the rich ship food as well as manufactured goods to the poor, and a payment crisis results.

The constant theme here is the intermediacy of technology, needed to exploit nature, and that can, on the one hand, multiply the gifts of nature many times and, on the other hand, diminish, even destroy, the natural environment. We think of three levels: nature, technology and population. Yet if natural resources do not predict population, neither do natural resources plus technology. Perhaps this means that the material environment is not the causal element in the resource-man relation. In any case, in probing the effect of environment the possibility cannot be overlooked that a productive environment in our wide sense actually diminishes population, as the theory of the demographic transition in fact says.



### Market Strength

In the system of exchange envisaged by the nineteenth century economists, advanced countries would trade their manufactures for the food and other raw materials of the then undeveloped world, including the United States. Each country would do what it could do best, following the law of comparative advantage. Markets would never long be oversupplied, nor would they be short. There would be no hungry people because those who did not engage in manufacturing would raise food for themselves and for export.

But in the curious upside-down world that has now emerged, the most advanced manufacturing country - the United States - gains much of its external revenue by its sales of raw materials. Its total exports of \$ 216 billion in 1980 included \$ 30 billion of food, beverages and tobacco, \$ 8 billion of fuels, \$ 23 billion of other raw materials, such as soybeans, wood and wood products and cotton. These add up to close to 30 per cent of all its exports. France also sells abroad both sophisticated manufactures and foodstuffs. Meanwhile sales of agricultural products from what formed the bread basket of Asia -- Burma, Cambodia, Thailand -- have fallen to the point where they make little contribution to world supplies.

The present condition, by which the United States can export nearly everything -- raw materials and manufactured goods as well -- to least developed countries (LDC) X, while X exports almost nothing to the United States, should not have come about. Even if the United States produces everything more cheaply, there should be balanced trade for each, and each should be selling what it produces most efficiently. The law of comparative advantage, owed to Ricardo, is succinctly expressed by Samuelson: "Whether or not one of two regions is absolutely more efficient in the production of every good than is the other, if each specializes in the products in which it has a comparative advantage (greatest relative efficiency), trade will be mutually profitable to both regions. Real wages of productive factors will rise in both places".24/

The theory of comparative advantage is logically impeccable, but in application elements that it does not take into account must be operating. Current disequilibria have many causes, one of which is the increased populations of the less developed countries, which have reduced exports of foodstuffs.

These once vigorous exporters demonstrate what it means to climb up on food supplies. Burma with a population of 15 million as little as 40 years ago was able to export three to four million tons of rice each year. Now its population is over 35 million and its exports for the period 1981-1982 have diminished to 700,000 tons. The three million ton drop in exports at one fifth of a ton per person is most of what the additional 20 million people need to live on. Insofar as those Asian countries that were major exporters of grain before Second World War have since increased in population sufficiently to take up their surplus, areas that formerly were importers, for example, exchanging jute or tea for rice, cannot obtain their cereal supplies in the area, but must resort to the world market. That is often cheaper than



local supplies, and contributes to a unification of the world market under a regime of very few exporters of foodstuffs, a condition that requires further attention insofar as animals compete successfully with humans for cereal supplies.

For 1982 world beef production is estimated to have been at 40,475 thousand tons; pork at 36,355 thousand, and poultry at 22,112 thousand, or about 100 million tons in all.<sup>25/</sup> This in effect would subtract some 500 million tons of grain from human consumption and is in a sense the reflection of income inequality.

### Inequality

On the one hand, we have the peculiar circumstance, developing about the time of Second World War, that the advanced countries - at least the United States and Japan - have high productivity in agriculture as well as industry and so do not typically buy food abroad with their manufactures. On the other hand, the LDC's have increased in population to the point where feeding their people is difficult, even in countries that formerly were exporters of food, with either domestic or foreign grain. The consequence is a gross inequality in the bare access to foodstuffs that the world market does not seem able to cope with. Countries that need more food for their poor populations, and that have no land on which to grow it and few other natural resources, ought to engage in manufacturing. Yet it will be a long time before Senegal can compete with Japan in the manufacture of audio equipment.

One way in which the imbalance shows itself is in indebtedness. Between food, equipment and fuel purchases on credit, the third world's indebtedness is now up to \$ 500 billion, most of it in short-term debt at current high rates of interest.<sup>26/</sup> Western banks have loaned Eastern Europe countries over \$ 50 billion from 1972 to 1982, with much of the current lending going to enable countries to pay interest on previously contracted debts. Mexico's \$ 80 billion of indebtedness is the most spectacular case of all, and is in part due to food imports needed to provide for its rapidly increasing population. Its vast supplies of oil have been an insufficient protection in the face of fluctuating oil prices. Bressand provides a fine analysis of the possible financial crisis and other features of instability in the world economy.<sup>27/</sup>

### The concentration of world agriculture

Will the bumper crops in exporting countries bring immediate relief of the payments crisis? Storage is nearly impossible to find in the United States, which has enough grain in stock to feed the country for 12 years.<sup>28/</sup> Grain prices are down by 25 cents or more per bushel from the targets of the United States Department of Agriculture, which will want to dispose of its large quantities of grain without creating chaps in the domestic market, and hence concessional prices can be expected. Such sales are in the short-term interest of poor countries, especially those with large city populations. Unrest among urban dwellers is a more immediate threat than the depression of



peasant agriculture. The coincidence of interest between the Government of an LDC, determined to feed its urban residents and to build industry, and the American need to dispose of surpluses is perfectly legitimate, but what if it holds back the agriculture of the poor country? And what if the urban populations are not in a condition to produce exportable goods to pay for the grain, even at low prices?

A real dilemma exists here. In the short run cheap grain supports population and indeed can avert starvation. In the long run it can build up large urban populations and then leave them defenseless against crop fluctuations and high interest rates. How can the rich country help? Better than grain at below-market prices would be to provide fertilizer; better yet to provide fertilizer factories, and best of all to provide the knowledge that would enable the factories to be locally built. The same sequence applies to all inputs: the farther back in the process the poor country can attain mastery, the less its degree of dependence, and the less danger that it will be left high and dry when conditions change in the benefactor country.

Unfortunately within the United States, France and other highly developed countries, the political pressure to export the finished grain is far stronger than the pressure to export knowledge that would produce grain.

The 1981-1982 crop year figures of the United States Department of Agriculture illustrate the degree of concentration in production and export to which the world grain trade has evolved. Net exports of the United States were 116 million metric tons, of Canada only one fifth of this, of Oceania and Argentina smaller quantities yet. Southeast Asia managed only 3 million tons.

### Sources of instability

It has been demonstrated that with world trade the relation of population to its food base is transformed into a relation of population to all resources. The USSR can comfortably sustain population by selling off a variety of resources; Saudi Arabia can do equally well with one resource; Japan's requirements are met with a trifling fraction of the proceeds of its exports.

Clearly, everyone lives better than they would if they were forced to depend on the produce of local lands. But the system is susceptible to many kinds of disturbance. Whole countries would go hungry if there were a crop failure in the United States that cut off their customary supplies. Others would go hungry if world market prices of their rubber, or palm oil, or cocoa, on which they have very little influence, were to decline sharply, or if bankers in New York and Frankfurt decided that they were no longer a good risk, even though their real prospects remained unchanged. People in the horn of Africa have been made miserable by political disorganization that cuts their supplies. Thus concentration leads to the risk of physical instability due to the weather, as well as economic instability in markets and credit, and governmental disorganization in countries less developed politically.



Even technological advance can be a source of instability. A given advance that benefits some can hurt others. An inexpensive way of getting the nodules of magnesium or nickel from the mid-ocean sea-bottom would lower prices and drastically affect the livelihoods - and the population-sustaining capacities - of countries that export those metals.

The greater the population in any country the more it is threatened by changes of many kinds. With 10 million people a country growing its own produce on small farms has only one thing to fear for its nutritional base - a local crop failure due to climatic fluctuation. Let its population grow to 20 million, half of them in cities and dependent on sales of raw materials or manufactures for their sustenance, so that they are participants in the world market for grain, and they are exposed to many potential hazards as they reap the benefits. The price of rubber in London becomes a matter of life and death for some. In turn, of course, their planting activities in Southeast Asia affect the London market, but in a degree far less fateful for London than for the growers. The growth of population in the third world, together with the concentration of internationally available food of which that growth is one of the causes, seems likely to generate larger waves than could possibly exist with smaller populations subsisting on local agriculture.

A distant but extremely serious form of instability threatens in the shape of long-run climatic change. Possible drastic changes, partly induced by the burning of fossil fuels resulting in increased carbon dioxide in the atmosphere, are not to be disregarded with impunity, even though their bad effects are still decades ahead.<sup>29/</sup> Such changes will have their most severe effect in altering the distribution of rainfall on the earth's surface; this is going to mean that one-time deserts will become arable, and, on the other hand, some arable lands will become desert. The more the population builds up in a given territory, the more it risks heavy mortality through the undercutting of the physical base on which it is supported.<sup>30/,31/,32/.</sup>

### Self-sufficiency

Under the pressures of development and the shortage of funds, and recognizing the elements of dependence described above, the LDC's are striving for self-sufficiency in food. Such an effort in effect takes them back to the epoch that the nineteenth century brought to a close, when every community, not to mention every country, was largely self-sufficient. Now self-sufficiency is sought as part of the struggle for development, which requires reserving the import capacity for purchase of capital goods - everything from lathes to steel mills. Any purchase of food abroad eats into the financial resources available for buying capital goods. When India was short 10 million tons of grain it had to spend a very large part of its total export income to buy it, so that the foreign capital part of its development programme was seriously affected. Self-sufficiency in foodstuffs resembles import substitution in manufactures; both are a retreat from a world market not seen as operating in the interest of the poor countries.



### Resources and politics

If the existence and distribution of natural resources is entirely unproblematical for the social scientist, who leaves such matters to geology, soil science and other specialties, the distribution of resources of skill, capital and power is an old theme of social science. In one form it is the classic historian's problem of the rise and fall of nations. The advent of world-wide markets has by no means eliminated politics and war among nations, as optimistic nineteenth century writers like Comte were sure it would. Political strength, on the one hand arises from concentration of (natural and created) resources and, on the other hand, makes possible further concentration of resources. This interaction of the political and the economic, the conversion of resources into power and power into resources, is a positive feedback that increases inequality among nations. In one manifestation in the past it was expressed as imperial dominance. If classical imperialism has disappeared, the commercial dominance and subordination of nations has not. The rhythm of rise and fall has accelerated; Japan has come to the top and the United Kingdom has sunk in a few decades, whereas the cycle of the Roman Empire occupied centuries. (Aside from the difference in time scale, Rome's fall was in part due to depopulation, while Japan's rise is accompanied by a virtual cessation of population growth.)

The interaction of political and economic elements in the utilization of resources may be clearly perceived within individual countries. In parts of Southeast Asia land is far more productive when used for rubber than for rice. A country would do better to plant rubber, sell the produce abroad and buy rice with the export income so obtained, rather than produce the rice itself. Is it therefore irrational for peasants to take over rubber plantations in order to plant rice? Not if one considers the internal distribution aspects of the takeover. Rubber sold abroad produces income for the central government; rice grown locally provides immediate consumption for the peasants who grow it. The peasant does not trust international markets, and even less is he sure that the receipts from rubber sales will be used to buy rice for him.

### Risks of instability superimposed on diminishing returns

A small closed population with fixed technology in a large area growing against its food supplies will for a long time have a fixed level of welfare. There will be ample arable land for each new generation, and no subdivision of plots will be necessary. But sooner or later a certain critical point will be reached where the limits of space affect the individual farmer; plots will be divided, and the standard of living will start to fall. This is a reality in Asia; the standard of living in many parts could well be lower than it was 200 years ago.

This pure effect of diminishing returns acts in several ways. While there is free land of equal quality to that in use there need be no wage labour and certainly no slavery. But insofar as the best lands have been



appropriated first, the lands that remain for new farms at any subsequent stage are less good, so average output will fall. Moreover the technology of simple plow agriculture is such that the size of plot each peasant can use is limited, perhaps to five or so hectares. Until all suitable areas have been occupied and divided into five-hectare plots, even with some heterogeneity of land, welfare is not likely to fall rapidly. All this is the classical theory of diminishing returns, expressed in its definitive form by John Stuart Mill.

In our century we need to superimpose on such static theory discontinuities and disturbances of many kinds. Even if land and its quality were fixed, agricultural output of a given territory varies with variations of rainfall, whether on the Great Plains of the United States or in the Siberian wheatfields. Water is a crucial element in the photosynthetic process by which grain or any other crop is produced.

In a given area the standard deviation of water supplies from year to year may be of the order of 25 per cent; the standard deviation of food output would be less than this because people would use the water more carefully when there was less of it; the standard deviation of the number of people that could live at the same calorie intake would be less again, because people would husband the grain more carefully in years of scarcity. It may be that the effective intake would have a standard deviation of only 10 per cent. But that amount of variation can be a matter of life and death for people who are at the edge of subsistence. Sheer starvation is not unknown, for instance, in a strip running south of the Sahara and down Africa's east coast. Satellite television permits well-fed people in one part of the world to watch from their living-rooms people across the oceans dying of hunger.

The number of deaths directly from hunger is less than from the malnutrition that leaves people susceptible to disease. There is no authoritative survey that tells just how many cases of malnutrition exist, though certain figures have been much repeated, but we can safely speak of hundreds of millions. Malnutrition raises death rates immediately in the years in which it occurs, and it leaves individuals weaker for the years ahead. Having supplies that are equal to need in the average year is not enough if good years alternate with bad.

How then to avoid the fluctuations that, more than average low supplies, are the scourge of certain areas, where they affect death rates catastrophically? There are only two methods of coping with fluctuations.

#### Meeting fluctuations

One method is by reserves that act as a buffer to convert a fluctuating supply in the fields into a continuous supply on the dinner table. As far back as the 1930s the United States started to carry an unplanned, and for the most part unwanted, reserve incidentally to its agricultural price supports. There is still some reserve that arises in this way; prices have fallen 5.1 per cent between September and October of 1982; they would have fallen far more without the intervention of the United States Department of Agriculture. The present reserve, supported by government financing, is enough to feed the



United States for 12 years, and it helps restore a margin of safety for world prices and supplies that has been lacking for some years.

The Food and Agriculture Organization of the United Nations (FAO) has recommended that each nation have its own immediately accessible reserve. Yet reserves are expensive. Between physical storage expense and interest charges on the money invested in the reserve stocks, costs are around 10, 15 or more per cent per year of the amount held, depending on how one calculates the real rate of interest. A way of spreading this cost so that it would be affordable, and shared in proportion to the benefits derived from the reserve, has never been arrived at. If each separate country were to be self-sufficient in the face of all contingencies, the cost of reserves would be formidable.

An alternative would avoid most of the cost of maintaining reserves: exchange. It happens that the record of the world grain crop shows little variation from year to year. Shortages on one continent have through the play of chance been offset by surpluses on other continents. All that is needed is that the regular channels of trade ensure that the surpluses shall flow to the places of deficit. But keeping the ports open in both directions is not always easy. Countries clearly in deficit want trade, and likewise so do those clearly in surplus. But the intermediate condition is more problematic; a country is just comfortable this year; its neighbours are decidedly short. The temptation to close its ports and so prevent price rises is strong, and stronger in the degree in which there is effective political participation of its people. What is needed on one model is a self-denying ordinance by which countries will give up the right to close their frontiers in either direction, and so provide an effective sharing of world supplies. One can guess that if such a measure is ever approached it will be with some elaborate safeguards and exceptions.

One of the circumstances that make free trade difficult to accept is that purchasing power varies so much from country to country. Completely free traded means that rich countries can afford uses of grain that would be submarginal in poor countries. I refer to the fact, pointed out by Alfred Sauvy, a generation ago, that under conditions of free exchange it may be possible for the rich man to feed his horse or his cow and deprive the poor man of the means to feed his family.<sup>33/</sup> That applies within nations and between nations. Internal inequality plus free exchange can even mean that the Punjabi landholder could sell grain abroad for cattle feed while his neighbours go hungry.

Apparently, free markets may support more population, and may support them better, than controlled ones, as certain countries are finding out. Beyond raising the average, free markets smooth out fluctuations over time. But they result in inequality. This underlies the drama of certain countries, where the Governments are seeking to attain the greatest measure of efficiency without excessively compromising equity. We cannot but note that limiting, even reducing, population is a crucial part of their strategy. For Ricardo, higher density increases inequality; he would have approved of population control in those countries.



### Technology

The inevitable main theme of any study of the effect of resources on population is the intermediacy of technology. Technical advances that could increase carrying capacity are numerous. Better control of pests, whether weeds or rodents; new plant like guayule that make use of hitherto unusable environments; recombinant DNA techniques to evolve bacteria that will fix nitrogen for grains, as they now do for pulses; better solar collectors for cooking and heating, which save wood and cowdung for other uses; ability to arrange the timing and location of rainfall; these are a few of the man-made changes in the environment that will enable more people to live and to live better.

The interface of technology with social organization needs attention. That countries in which labour is expensive have been the main sources of new technology has resulted in a bias towards devices that are labour-saving rather than capital-saving. Where invention takes place among relatively plentiful materials (either because of low density of population or ability to command materials from abroad), there will be less emphasis on techniques that are material-saving. Some redirection of technology is needed in a epoch when people are numerous and their living standards press against the carrying capacity of the planet.

That specialized knowledge and advanced capital are now needed for making capital items (or even consumer like hand calculators or vacuum cleaners) prevents the simple conversion of labour into manufactured goods, the process described by Adam Smith and by Marx. Early economists thought of capital as locally made, and all that was needed to secure it was to provide the subsistence of the labourer. Capital has now become an indispensable and separate factor of production, which poor countries can only acquire by purchase abroad. Innovations of a kind that will permit the poor country to create its own physical capital items with its own plentiful labour are a pressing need; what can be done to generate them?

Any technical innovation that makes the process of capital accumulation accomplishable by local labour using local materials will at one and the same time put the third world's unemployed to work and accelerate development. The kind of foreign aid that was noted here of in respect of agriculture (not food, but fertilizer; not fertilizer but fertilizer factories etc.) has its clear analogue for industry in contributions that go back up the chain, from consumer goods to factories for making these, to new technologies that permit LDC's to make their own instruments of production. Whether the advanced countries can be persuaded to use their inventive capacities to aid in this way is not clear.

### Synthetics make room for more population?

The ability of the world's tillable lands to support population has always depended on technology. With slash-and-burn agriculture, as in pre-Columbian America, or in parts of Asia far from the river valleys, about



15 people per square kilometre can be sustained. Once there is a changeover to irrigation this figure rises to several hundred. In recent years new ways of conserving land have come into widespread use; natural fibres and other commodities competing with foodstuffs are now replaced by factory products. From slash-and-burn agriculture up through synthetic fibres we have a sequence that enables even more people to live on the planet.

Rapid technical progress in the direction of saving land is reflected in the production statistics of the past few years. We see striking declines in cotton yarn, with the United States dropping from 2,005,700 metric tons in 1966, its high point of recent years, to 1,397,200 tons in 1973. Cotton fabrics produced declined from 8,083 million metres in 1966 to 4,650 million in 1973. A lesser product, natural silk, declined even more, from 16,205,000 metres to 5,645,000 metres. The same story applies to wool yarn and wool fabrics - the latter down from 242 million metres in 1966 to 97 million in 1973. The old synthetics, rayon and acetate, held about level; all of the decline and more was made up in non-cellulose fibres. Continuous non-cellulose filaments went from 528,000 metric tons in 1966 to 1,515,000 tons in 1973; discontinuous filaments rose from 416,000 to 1,347,000. This extraordinary substitution of synthetic for natural fibres appears in almost equal measure in other industrial countries and is evidently world-wide.<sup>34/</sup>

It applies also to rubber, butter (as margarine takes its place) to a prospective electronic newspaper that would be independent of newsprint. Existing television communication has already greatly reduced the use of newsprint and the number of newspapers compared to what they would have been without television.

One would think that such land-saving would help marginal populations, those who will go hungry unless more food is produced. Yet the advent of synthetics is in the short run damaging to the poor countries that produce the natural product. Indonesia and Malaysia can realize a larger return per acre on rubber than on rice at the market prices of both that have prevailed. Their immediate capacity to buy industrial equipment is adversely affected by the competition of synthetics. While the invention of synthetics is a long-run boon to population in the world as a whole, it sets back near-term national plans for economic growth. (We have seen how elites and peasantry differ on the utility of grain versus export crops.)

#### New technology

No one can say in what degree the technology of the half-century ahead will be land-saving, but one can speculate on such of the advances mentioned above as the electronic newspaper. How much land would it save? Some 11 million tons of newsprint were consumed by publishers in the United States in 1980 <sup>35/</sup> of which two thirds was imported from Canada and elsewhere. If the paper is made out of wood, and there is a salvage rate of 25 per cent (the United States rate is 21 per cent, Western Europe manages 29 per cent), then 7.5 million tons per year of wood fibre are needed, and at 2 1/2 tons per hectare this occupies 3 million hectares of land. But some land is not of use for any other purpose, and other land needs to be covered with forest for



water conservation, or is used for recreation. Suppose the net saving of possible agricultural land would be one third; the electronic newspaper would save 1 million hectares that could provide food for 10 million people.

Electronic conferencing would not save agricultural land, but it would save air travel and hence fossil fuels that could be made into fertilizer, and so the equivalent of land. A high proportion of air travellers are going to or coming from meetings that could well be replaced by communication devices that achieve the results of face-to-face discussion and negotiation.

Many technical advances could be brought into existence to extend natural resources, create new resources, and otherwise increase the capacity of the planet to hold more people and permit them a degree of amenity. For instance, methane is widely present in the earth's crust and can be produced from biomass and from coal in virtually unlimited quantities. Conversion of present vehicles to methane use is not difficult, and the cost of methane is comparable with that of gasoline. Like other materials-gaining technologies, the widespread use of methane would diminish the demand for crude oil below what it would be in the absence of methane, and would establish a new equilibrium in world financial markets.36/

The application of genetic engineering to produce new crop varieties and animal strains seems close at hand.37/ But we do not need to wait for new species. All over the world species are known that require only to be disseminated and exploited. Mexico has recently been putting guayule to use for the production of rubber.38/

Every such development will harm someone in the short run (the newsprint industry, the airline, oil producers, rubber growers) and increase both welfare and population-carrying capacity in the longer run.

### Shortages and birth control

The classic notion that every mouth that comes into the world brings with it a pair of hands is not very helpful, as Mill pointed out, if the additional pair of hands cannot find good land or capital on which to apply effort. Effort can indeed be intensified on existing land, but greater efficiency, including use of tractors, often permits higher output with fewer workers. Some land in many countries is over-used, becoming arid, over-irrigated, or salinated. Some countries have plenty of land, but their people lack the incentive to work it; one effect of education is to make people dissatisfied with the petty subsistence agriculture of their ancestors.

The output of foodstuffs beyond the needs of the producers, that surplus that is needed in the cities, declines with the growth of population. At the same time people not finding suitable employment on the land move to the cities, whose populations grow at anything up to 5 per cent per year. The United Nations estimates a five fold growth in LDC cities in the short period from 1960 to 2000.39/ Such effects of population growth have turned the thinking of initially pronatalist Governments to birth control.



Governments of many poor countries are promoting birth control today, where as recently as the 1960s they were indifferent to population growth or even actively encouraged it. The disappearance of the agricultural surplus deprives peasants of their traditional function, to sell foodstuffs in order to pay taxes and buy consumer goods, and so enable the cities to subsist. Worse still, the peasants themselves come to the cities; Cairo has grown from 3 to 9 million in two decades; Mexico city is said now to contain over 12 million people. Often jobless, the newcomers demand not only food but a variety of services. The foreign exchange cost of an unemployed population that depends on the Government for its sustenance is disastrous for development plans that need foreign equipment, and fatal to hopes of financial independence from foreign bankers and grain sellers.

Technology as intermediate between the environment and the population that it supports has been mentioned here. But also government comes as an intermediate agent, an agent of adaptation of population to land between the environment that would limit population and the population itself. Government evidently plays a role, on the one side, in introducing better methods and so lifting the environmental constraints on population, and, on the other side, in limiting population to what the environment can stand.

Acting to some extent independently of government are a host of institutions that are also intermediate between the environment and the population that it is called on to support. Some have already been referred to, but others deserve mention.

#### Institutions and the birth motive

It is easy to rationalize away the population problem. If the poorest countries would show as high rates of economic advance as Japan and the Republic of Korea have done, they would quickly approach their demographic transition. If there were no national restrictions on trade, and buying power sufficed, then even at the present time food would be adequate for all. If the Japanese would only eat rather than rice, they could get enough carbohydrate per acre; if they could attain the yields of Japan or Iowa, they could eat plenty of whatever they wanted.

The population/food problem consists in the fact that these things are not done easily. Nationalism, cultural preferences in food, inefficient agriculture and urban-centred development are real and persistent. So is the large-family culture in many parts of Asia, Latin America, and especially Africa. To wish these things away is as unrealistic as to ignore shortages of physical resources. The control of oil supplies by a dozen countries in order to promote their national interests, is as much a part of the energy problem as the ultimate exhaustion of the oil fields. It must be insisted that social institutions may be as hard to change as the constraints of the physical world.

That demographic variables depend on the milieu, the productive capacity of the area in which the population is located, but depend on it through the intermediate variable of institutions, is seen in respect of old-age security. It may be shown how in one set of circumstances the need of people



to provide for their old age causes them to have many children, and in other circumstances causes them to refrain from having more than one or two.

Think of a limited territory with privately owned land, in which each peasant owns about the amount that he can cultivate with the aid of his wife and some modest equipment, perhaps 10 hectares. There is no other land readily available, and to divide the family plot among half a dozen children when the original peasant can no longer work it would be disastrous. The old-age security of the peasant depends clearly on his having one capable son, or a daughter who can attract a son-in-law, to work the farm. This may well have been the condition of France about the time of the Revolution; its peasants were preoccupied with their private landholdings and rural birth rates were the lowest in Europe.

Consider in contrast to this another way in which population is sustained: by artisanal manufactures - using the word in its literal meaning of articles made by hand labour. Europe showed the incipient forms of modern industry in the eighteenth century: plenty of wage jobs, with long hours and low pay. In the areas of such industry birth rates tended to be higher than in the parts of Europe that were purely agricultural. In a regime of wage labour the peasant who has many children and can send them out to work will draw a small income from each. He needs many to live comfortably in his old age. This is the opposite of the case where freehold landed property provides the incentive to have few children.

In one sense all cases can be assimilated together under the notion of accumulation of capital during working life that is to be drawn on when working life is past. The accumulation may take the form of buying or developing a farm; it may take the form of cash savings, as long as these are not subject to the risk of theft or inflation; it may take the form of bearing and raising children who would be sent out to wage jobs, provided the culture is such that the children will devote their wages to the care of their parents. Where land is plentiful, either in the virgin forest or in the hands of others willing to sell, as in French Canada during much of the nineteenth century, one can have the benefit of seeing one's patrimony extended in each generation. At the same time in French Canada there was plentiful employment to be had at low wages, and so it was worthwhile to raise children, both for working the additional farmland that one bought or reclaimed from the wilderness, and for sending to the textile mills, perhaps with a son for the priesthood. Except for the priesthood, the configuration was not very different from that in New England up to the time of the Civil War, and on both sides of the border the birth rates were nearly as high as have ever been recorded.

The conclusion from this quick survey, partly derived from Tilly,<sup>40</sup> is that the motive of old-age security can lead people to have many or few children, depending on the means available for providing an income after one has ceased to work.

Can such institutions be fashioned as policy instruments? In populations that are already dense the room for manoeuvring is limited. It would be good to provide every Indian family with three hectares of good land, say, in



private ownership, and so an incentive to keep the patrimony intact by having only one or two children. That is hardly feasible; the land is not there. An alternative would be to encourage saving for old age by providing a stable repository of value other than land; let the peasant save for his old age, but in something more solid than inflating paper money.

The saving could be forced: the state would collect taxes to provide an income to those past a certain age. This, essentially the old-age security system of the welfare state of Europe and America, has undoubtedly had an effect on birth rates in the most developed countries and has been seriously suggested for India; but when we see to what intolerable cost it has led in the wealthy countries that devised it, and the consequent disillusionment with the welfare state now current in Europe and America, it seems hardly a means for a poor country to control its fertility.

If family discipline weakens, so that children can not be expected to support their aged parents, then the incentive to have children weakens. Such slackening of family discipline is associated with education, but disloyalty to parents is hardly to be promoted by Governments, even though that may be part of what has lowered birth rates in the West. Many important institutional variables are not readily subject to policy manipulation.

If no one of this series of considerations can by itself constitute an effective policy, what policy does emerge? A combination of all seems to be the answer. A one-time division of land among the peasantry, so that as many as possible have an area sufficient for one family to live on; means by which people can effectively save, if not a stable currency, then indexed bonds, permitting older people to continue working at wage jobs as long as possible, with modifications of the work to accommodate their weakening powers; extension of education that not only teaches substance, but orients children in the direction of their own personalities and careers.

#### Effect of urbanization

For long ages it was possible to say that urbanization as such was a way of bringing down the rate of natural increase. During the European Middle Ages and after cities did not replace themselves; their death rates were higher than those of the countryside and their birth rates lower, so that without a flow of immigrants a city would disappear. Given the unhealthful conditions and the difficulty of making a living in them, people came to the cities reluctantly, and only in proportion as jobs in industry opened up, a process described by Adam Smith for the Scotland of his time. Often migration was in stages, first to smaller cities, then from these to larger cities.

None of these statements is true today. Cities have high rates of birth, and their death rates are no higher than those of the countryside, so that much of their growth is simply natural increase. The immigrants to the cities do not wait for the evolution of industry; they come with or without the prospect of jobs. Moreover, the greatest movement is to the biggest cities, to national capitals in particular. The cities of today are building up in a context of rapid population growth in the countryside, whose natural increase is far larger than that of rural nineteenth-century Europe.



This contrast between the urbanization of the nineteenth century and that of the late twentieth is suggested by a recent United Nations 41/ report. While the cities of the more developed countries will double in population between the years 1955 and 2000, those of the less developed countries will multiply by more than six. About 1970 the total urban population of the less developed countries became greater than that of the more developed countries, and by the year 2000, within the next 20 years, the less developed countries' cities will contain fully double the population of the cities of the most developed countries again according to the United Nations medium projection.

A further contrast: when the presently developed countries were industrialized it seemed as though the countryside was being emptied by the move the cities; English nineteenth-century writing includes many complaints about abandoned farms in half-deserted communities. United States cities grew with the mechanization of farming that released manpower from the countryside. Up to about 1970 half of the rural counties of the United States were actually falling in population - though that is no longer true. But in the present LDC's the rural areas on the whole continue to gain - at a rate of 1.75 per cent per year estimated from 1960 to 2000. Overall population growth is so great that the cities can multiply by six and the countryside still add 80 per cent between the years 1960 and 2000.

#### The impact of development on population

The immediate effect of development and modernization has often been to accelerate the growth of population. At least, the United Kingdom went from 9 million in the census of 1801 to 36 million in 1901, a quadrupling during the course of one century that combined unprecedented population growth with unprecedented development. Other countries of Europe also increased their population during the course of their development. The United States grew rapidly up to about 1870, a period that somewhat preceded its industrialization; after industrialization got under way about the time of the Civil War, births slowed. In the currently less developed countries, as in the United States, the growth of population has preceded that of industry - the expansion being due essentially to the decline of mortality, though in some instances fertility also rises in the first stages of modernization.

Thus, one cannot generalize on the immediate effect of modernization - either that it always accelerates population growth or that it reduces it. But the proposition that full development ultimately lowers the birth rate sufficiently to more than offset any decline in mortality does seem to be universally valid.

The proportion of world population constituted by the present most developed countries went from 26 per cent in 1800 to 35 per cent by 1900, and is projected to be down again to 21 per cent by the year 2000. Thus it seems that after a quarter of a millennium the distribution of the population between the most and the least developed countries as they are now defined ends up where it was at the start of the world-wide process of development. The case of Africa is special; it had about 10 per cent of the world's population, dropped to less than 5 per cent by the end of the nineteenth



century, has now recovered to 10 per cent, and could well get to more than 20 per cent before it becomes stationary.

It is foolish to think in terms of an intergroup competition for who can multiply to the largest extent. That view is obsolete in an age when the welfare of the masses, not their numbers, is the prime objective. Two groups in competition, whether families, tribes or nations, can both reduce themselves to misery by making the focus of their competition not development and welfare, but numbers. China expresses this clearly in the influential, if not unanimous, wish for 700 million prosperous Chinese rather than double that number in poverty.

Once welfare is recognized as the goal, a divergence still exists on the means. Should family planning be instituted as a precondition for development, or should a country proceed directly to development with the confidence that once a degree of economic advance is attained family planning will follow by itself? The issue goes back a long time, and was given particular salience at Bucharest and in the period that followed.42/

### Summary

The simple model in which population increases to the number permitted by food supplies may well be useful for the study of many animal species, but becomes less and less applicable to humans as the level of technology rises and institutions are formed. In particular, it is rendered inapplicable on a local scale by the world market in foodstuffs, and has to be altered to a relation of population to all resources, including manufactures and services. The support of population through the production of foodstuffs in the places that can produce most efficiently carries advantages as well as disadvantages. In the present operation of international trade, the production of both foodstuffs and manufactured goods goes on efficiently in a few countries, while the majority of LDC's suffer very high levels of unemployment and inefficiently used labour. The result is a crushing burden of indebtedness that threatens the world financial system, whose collapse would remove the subsistence base of many of the cities of the LDC's. Added to potential financial instability are instabilities due to climatic variations from year to year and risks of permanent deterioration of the environment.

Between the physical environment, on the one hand, and the number and welfare of the human population that is ensconced in that environment, on the other, a number of intermediate variables are interposed. They include technology, social institutions, especially forms of landholding, security for old age, and schooling.

The question was first asked here whether the ecological considerations developed in this paper can increase the accuracy of population projections. The method that emerges is first to project the condition of the environment, whether for Mali or for Brazil, and then the intermediate variables of technology (including the capital that embodies technology) and institutions, and so proceed to the population that would be sustained, say in the year



2030. No one can claim that this is easy, but accurate projection is not easy by any other method either. Once this is done for a given future time, the obtaining of populations from year to year between the present and 2030 would be by straightforward interpolation.

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## II. POPULATION

### A. Long-term effects of global population growth on the international system

Paul Demeny\*

International dimensions of the relationships between population growth and development represent a relatively small subset of the issues that would be involved in a comprehensive discussion of such relationships in the contemporary world. The overwhelming proportion of what might be construed as "population problems" is located - and dealt with in one fashion or another - within the geographic boundaries of sovereign States. Much of what is often discussed under the loose label "world population problems" reveals itself, upon closer examination, to be a collection of a multitude of national problems.

Despite their surface diversity, the underlying structure of such national population problems is identical. The myriads of discrete actions that determine demographic processes are governed by a calculus of advantage and disadvantage as perceived by individuals. However, under the existing arrangements regulating social interaction, some of the consequences of individual demographic acts are borne by persons who have had no influence on the process of deliberation that led to a particular demographic decision in the first place. Such "demographic externalities" which emanate from individual actors are likely to be minute in size in any particular case, but they may be of great significance in the aggregate. Welfare transfers, whether negative or positive, may flow predominantly from individuals of certain demographic or socio-economic characteristics to others, thus leaving some groups relatively worse off while others experience net gains. Or, the effects may be mutual and symmetrical, each individual or group of individuals both transferring costs to others and bearing costs transferred by others. This may leave relative welfare positions largely unaffected, yet make everybody less well off than they might have been if the costs generated by individual demographic acts were fully borne by the relevant decision-makers. In such situations, there is a potential for mutually agreed-upon social interventions aimed at influencing the outcome of individual-level decision-making in demographic matters - interventions that would enhance the welfare of at least some in the society without diminishing the welfare of others. The intervention may consist of legally binding rules concerning demographic behaviour; education and other forms of normative persuasion; or, most plausibly, changes in the institutional environment that modify the cost calculus individuals make in demographic matters.

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\* Director, Center for Policy Studies, The Population Council. The opinions are those of the author and do not necessarily reflect those of The Population Council.



Since nations do not live in hermetic isolation, *prima facie* demographic externalities are not fully contained within national boundaries. Indeed, in principle, international population problems possessing the same underlying structure as national problems can be readily identified. Naturally, the significance of international spillover effects attached to demographic behaviour is not to be taken for granted *a priori*. For instance, it would be reasonable to expect that in many cases sheer geographic distance might be enough to weaken such effects sufficiently to make it doubtful that there is scope for a social welfare improvement on the international level through population policy measures. But, whether countries are adjacent or distant, it is the very existence of international boundaries that tends to constitute the most important barrier to the transmittal of significant demographic spillovers. Such boundaries demarcate the main units within which population externalities can be not only identified but also acted upon. National entities possess the ready machinery of the state for political bargaining and decision-making and for enforcing rules and executing policies once they are adopted. In contrast, supranational organizations endowed with analogous attributes exist today only in rudimentary form, and what powers they do possess are ill-suited for formulating and enforcing population policies on a global or even a regional scale.

Yet the international system is affected by demographic developments within its constituting units; hence, it has a stake in the manner in which member States handle population matters. On the most obvious level, policies controlling the settlement of foreigners in a national territory have an impact outside the country that exercises the control, even though international law recognizes the right of sovereign States to set such policies at their own discretion. The history of international migration policies is, of course, as old as the nation-state itself. As long as the nation-state remains the basic building block of the world system, the existence of such policies will be a permanent fixture of the regulatory mechanisms that shape global demographic trends. Since the end of the Second World War, national interests in political matters have also become interlinked in a more explicit fashion. A number of Governments, concerned with economic and social ills that appeared to be aggravated by an unprecedented surge of population growth in the less developed countries, have taken an open interest in overall demographic trends outside their own borders. A less than disinterested governmental role in international fact-finding and analytic work concerning population change has, of course, numerous historical antecedents. But the direct involvement of national Governments in population policy formulation and execution in other countries, which has characterized the post-war period can be regarded as wholly novel. This new-found interest has manifested itself in two main forms.

First, bilateral contacts between Governments came to involve population policy matters. Increasingly, in intergovernmental discussions of economic and social issues, concerns about the interrelationships between population dynamics and development trends were explicitly raised and, as part of development aid (itself, of course, a new facet of international economic relations), financial assistance and sometimes operational partnership were sought or offered for the establishment and support of "population programmes". Second, the issue of world population trends was put on the



agenda of international organizations, most notably in the United Nations and its specialized agencies. This initial focus was on the promotion of data-gathering and scientific work, but increasingly programme assistance was also made available to States requesting it. Activities under these rubrics have grown rapidly in volume and visibility, especially during the last 10 years.

### Population growth and the international system

What are the main factors underlying the increasing attention given to population policies on the international scene? The answer may be approximated by noting four overlapping and interrelated concerns that appear to influence, if unevenly and in varying combinations, the approaches towards international population phenomena embodied in national policies. The concerns have to do with (a) shifts in relative demographic size within the family of nations; (b) international economic and political stability; (c) humanitarian and welfare considerations; and (d) narrowing options with respect to long-term social development. Each of these concerns is a reflection of measurable or perceived consequences of the extraordinarily rapid growth of the world population during the present century and in particular of the marked acceleration of that growth since the end of the Second World War. None of these concerns has been adequately articulated, either in the academic literature or in international and national forums in which population policies are considered. The general tone of the ongoing policy discussions has been, and remains, intensely pragmatic: discussion is focused on what appears to be feasible at the moment, and aims at patient widening of the existing scope of co-operation between national Governments.

Given this orientation, the inclination to be perfunctory concerning the rationale for any particular action or even for a general policy is not unexpected. It reflects the political sensitivity of the issues involved and the fragility of the value consensus, whether between nations or in the domestic arena, on which policies are based. It also reflects what Tinbergen characterized as a "pre-scientific stage of understanding the problem and its solution".<sup>1/</sup> Even when demographic patterns and magnitudes can be ascertained (a condition often far from being satisfied), there remains wide disagreement concerning the influence of these patterns on human welfare and the nature of their interaction with other social phenomena.

Resolution of such disagreements has thus far proven elusive. International co-operation in the meantime has proceeded along the line of least resistance. For better or worse, this has entailed a degree of obfuscation concerning policy rationales and goals. Instead of an examination of principles and foundations, there has been a concentration on what was politically attainable: ad hoc international co-operation aimed at moderating population growth. The bargains struck typically involved tangible, if thus far decidedly small-scale, transfers between nations - transfers earmarked for encouraging the establishment, and assisting in the execution, of national population programmes whose ends and means met outside sympathy and concurrence. The goal of a constitutional-level international contract spelling out a code of demographic behaviour applicable to the members of the family of nations has been seen, probably correctly, as out of reach.<sup>2/</sup>



Thus, international action in the population field has become a subset of international development assistance. Among the motivating concerns listed above, item (c), humanitarian and welfare considerations, has received most attention, both in marshalling domestic concerns for supporting international assistance in population matters and in underpinning the willingness of recipient nations to co-operate. Considerations of economic and political stability, item (b), also have been often invoked, at least in justifying donor interest. Items (a) and (d), in contrast, have been seldom discussed, owing, no doubt, to the feeling that they touch on sensitive nerves and to the fact that they focus on consequences of population growth that are long-run as well as poorly quantifiable. Nevertheless, a careful reading of the record of the policy discussions of the last few decades leaves little doubt that the influence of these factors has been potent.

#### Shifts in relative population size

The explosive increase of the world population is perhaps the single most spectacular event of modern history. Global numbers during the last 100 years have trebled. Net population growth between 1900 and the year 2000 will, in all probability, be of the order of 4.5 billion. During the first quarter of the twenty-first century an additional net increase of 2 billion is anticipated by the United Nations. Underlying this expansion are sharp differences in observed and anticipated national and regional growth rates. From the point of view of the slower-growing nations, this feature of global demographic growth is a source of obvious if ill-articulated long-term concern. In the domain of evolutionary theory, the consequence of any sustained difference between the rates of growth of two populations occupying the same ecological niche is straightforward: the eventual complete displacement of the slower-growing population by the faster growing one.<sup>3/</sup> Since among human populations rates of growth are subject to social adjustment, and relative magnitudes may be reversed by conscious action, the biological principle is not directly applicable. Nevertheless, the shifts in relative demographic weights can be remarkably rapid and, barring catastrophic developments (which of course may also reinforce the existing trend), non-reversible.

A few examples illustrating the shifts in relative population sizes should suffice. Europe's population was 17 per cent of the world total in 1900 and 15.6 per cent in 1950. It is 10.9 per cent today, and this share is virtually certain to fall to 8 per cent or less by 2000. Expected trends in the twenty-first century are elaborated in a number of recent long-term population projections.<sup>4/</sup> Europe's population in 2025 is forecast by the United Nations at 6.4 per cent of the world total; Frejka anticipates eventual stabilization at about 4.4 per cent. The relative ranking of individual countries exhibits similar pronounced shifts. Thus, France, the world's fifth largest independent country in 1900, ranked tenth in 1960, fifteenth in 1980, and will rank twentieth in the year 2000. France's stabilized rank in the twenty-first century is forecast as thirty-second by the World Bank.

Although the countries of Europe represent the most direct instances of declining relative demographic weight, similar shifts are observable



elsewhere. For example, the population of northern America (essentially, Canada and the United States of America) in 1950 still exceeded that of Latin America and the Caribbean. Today, the latter region has a larger population by some 120 million; in the year 2000 the gap will be, according to the United Nations, 267 million. In 2025 it will exceed 520 million.

It is well known that analogous shifts within countries that comprise distinct sub-populations (distinguished by, for example, ethnic, linguistic or religious differences) tend to generate great anxiety among the members of the groups suffering relative decline and are a source of social tension or, at least, of perceived potential internal power conflicts. Among the many contemporary examples, reference to the Union of Soviet Socialist Republics (where between 1970 and 1979 the population of the Slavic republics grew by 6 per cent and that of the Central Asian republics by 28-31 per cent) and to such small countries as Lebanon, Malaysia and Sri Lanka should suffice.

Transposing such anxieties to the international scene is not straightforward, but the general disinclination to discuss the issue is deceptive. Historical experience suggests that, in the long run, relative demographic weights tend to translate into relative political and economic power. The contrasting fates of the European colonization in the Americas and Australia, on the one hand, and in Asia and Africa, on the other, are instructive. Of the two great European wars in the twentieth century, the first ended with an extensive redrawing of the political map to better approximate demographic boundaries. More ominously, the second established a historical precedent for redrawing the political map to reflect massive demographic shifts imposed through force.

Clearly, the stability of the existing division of the world among nation-states rests ultimately on relative military power. It is equally evident that such power in the contemporary world is poorly correlated with demographic growth rates or even with absolute demographic size. But in a long-term perspective, the eventual emergence of a strong, positive correlation is an entirely plausible expectation. Sharp differences, especially between adjacent countries, with respect to population size, density and population-to-natural resources ratios are a potential source of instability as they create the temptation to achieve equalization of differences through force.

Thus, the present pattern of demographic growth differentials in the world represents a serious long-term problem from the point of view of the slower-growing nations. Sustaining these differentials for a long period would tend to lead to increasing international tensions and perhaps even to the eventual imposition of adjustments of national boundaries. The elimination of such demographic growth differentials, through a reduction in the rate of increase of the rapidly growing nations, may therefore appear as a condition of long-term peace and overall stability within the international system.

There is strong reticence on the part of slow-growing nations to stake out such a claim. However, in a muted way, the objective of equalizing rates of demographic increase internationally is implicit in the population



projections cited above. Ostensibly, these projections are artifacts of demographic analysis, reflecting the best guesses on the future evolution of demographic behaviour. Yet, the grounding of the governing assumption of the projections - that replacement-level fertility will be attained in all countries within a relatively short span of time and from then on will be sustained indefinitely - is plainly tenuous. The projections of demographic developments in the twenty-first century are best described as normative: they express a hope and spell out a suggested timetable against which the actual time-path of demographic variables can henceforth be measured.

### International economic and political stability

Concern with the deleterious consequences of rapid population growth on domestic economic development and, by extension, on the health of the world economy is a major factor in explaining international interest in population matters. Reduced to the most basic terms, economic improvements in the less developed world require rapid accumulation and effective application of human and physical capital. Human capital growth assumes achievement of adequate standards of health and nutrition, the elimination of illiteracy, and the acquisition of technical and entrepreneurial skills through formal education and through work experience in productive activities. Capital accumulation calls for the postponement of current consumption. Each of these requirements is rendered more stringent and more difficult of achievement under conditions of rapid population growth. Societies experiencing such growth have an age structure heavily biased in favour of youth, with proportions under age 15 of around 40 per cent and often higher. The high youth dependency burden tends to dilute both parental and collective provision of health care, nutrition and education for children, with harmful eventual consequences for their productivity as adults. The rapid growth of the population of working age depresses capital-to-labour ratios, interferes with the adoption of modern technologies and aggravates unemployment, while making capital accumulation more difficult. Elimination of the structural imbalance characterizing underdevelopment in the contemporary world - the coexistence of a technologically advanced subsector with a traditional low-productivity economy - is retarded by rapid demographic growth, which both causes the rate of growth of the modern component to be lower than would otherwise be possible, and expands the size of the traditional economy.

The considerations just noted have to do with rates of change and structural characteristics. In a number of developing countries these problems are also aggravated by the excessive size of the existing population relative to resources and available technology. When such circumstances prevail, even in the absence of demographic growth, development is hindered by the need to exploit resources that require the application of large amounts of capital per unit of output (for example, in making marginal lands suitable for agricultural production, in conducting off-shore mineral exploration, or in maintaining or achieving a given standard of environmental sanitation). The spatial redistribution of populations necessitated by development also entails various diseconomies, such as those associated with urban concentrations beyond a certain scale. Population growth amplifies such problems greatly.



Whether a given population size or a given growth rate is deemed excessive, the problem generally perceived is not that these demographic factors will lead to catastrophic events within a historically short span of time, nor even that such growth precludes material improvement.<sup>5/</sup> Although the possibility of demographic growth-induced localized breakdowns cannot be ruled out, the effects of rapid population growth according to most analyses are relative: a slower rate of improvement than would otherwise be feasible. There is a broad consensus among economists that, save for special circumstances seldom found in the economies of the contemporary world, very rapid population growth - of the order of 2 per cent per year or more - is likely to be a major hindrance to development.<sup>6/</sup>

At the level of the international economy, differential demographic growth contributes significantly to maintaining and even to widening the prevailing large income differentials between rich and poor countries. It is virtually certain that such income differentials will persist during the coming 50 years, in no small measure owing to demographic growth patterns.<sup>7/</sup> In view of the initial disparities in income per capita, as long as there is substantial positive growth in the high-income countries, a widening of the gap between rich and poor countries is, of course, an arithmetic necessity as far as absolute differences are concerned. To narrow income differentials reflected in the more relevant measure - the relative size of per capita incomes - requires a faster rate of improvement among the less well-off countries. In the last 20 years, high rates of population growth greatly narrowed, and in many instances more than wiped out, the relative gains that developing countries could otherwise have realized from their generally high rates of growth in terms of aggregate income.

The disparities in demographic patterns between the broad categories of developed and developing countries manifest themselves in many important facets of economic performance. Thus, for example, differential demographic growth tends to shift the terms of trade against many primary products exported by developing countries. Similarly, contrasting growth trends in the population of labour force age accentuate the differences in employment opportunities and in relative factor prices between developing and developed countries. At present, as a result of past demographic trends, the effect is particularly strong with respect to the prospects faced by persons in the young labour force ages. For example, between 1980 and 2000 the age group 20-39 will be increasing at the annual rate of 2.45 per cent in the developing countries, in contrast to a rate of 0.24 per cent in the developed world. (Excluding China, the rate ranges between 2.8 and 3.2 per cent in the major developing regions.) In absolute terms, the net increase during this period will be 17 million in the developed countries as a whole and 60 million in the developing world.<sup>8/</sup>

Although the great diversity of development performance within the so-called third world makes generalization difficult, it is clear that the ongoing process of rapid demographic growth puts heavy additional pressure on the changing social and economic fabric of most developing countries. Amplified by rising expectations that result from increases exposure to the outside world, dissatisfaction of significant segments of the population with their status is likely to grow. Almost by definition, development implies



differential improvement in material conditions, leading to sharpened class conflicts and regional antagonisms. The weakening and eventual breakdown of social institutions that have accommodated poverty and mediated between conflicting interests in the traditional society expose some groups to particularly harsh conditions. The loss of political cohesion that results tends, in turn, to worsen economic and political weakness of Third World Countries, and this interferes with the development of stable trade relations and the international flow of capital, further hindering material progress.

It follows from the foregoing that policies that would reduce population growth could have highly beneficial economic and political returns. On this issue - unlike that discussed in the preceding section - the perspectives of cooperation between nations can be found, aimed at promoting policies that promise to reduce undesirably rapid population growth. From the point of view prevailing large income differentials between rich and poor countries. It is virtually certain that such income differentials will persist during the coming 50 years, in so small measure owing to demographic growth patterns. 7/ In view of the initial disparities in income per capita, as long as there is substantial positive growth in the high-income countries, a widening of the gap between rich and poor countries is, of course, an arithmetic necessity as far as absolute differences are concerned. To narrow income differentials reflected in the more relevant measure - the relative size of per capita incomes - requires a faster rate of improvement among the less well-off countries. In the last 20 years, high rates of population growth greatly narrowed, and in many instances more than wiped out, the relative gains that developing countries could otherwise have realized from their generally high rates of growth in terms of aggregate income.

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It follows from the foregoing that policies that would reduce population growth could have highly beneficial economic and political returns. On this issue - unlike that discussed in the preceding section - the perspectives of developing and developed countries are likely to overlap. Thus, scope for co-operation between nations can be found, aimed at promoting policies that promise to reduce undesirably rapid population growth. From the point of view of individual countries, the perceived payoffs are primarily domestic economic and social gains. In contrast, the perspective of the developed countries on the matter is international. For them the appeal of such policies lies in the hoped-for result of greater political tranquility in friendly countries, greater stability of international relations, security of export markets and sources of needed imports, and reduced pressures for unilateral international wealth transfers from developed to developing countries. International organizations that seek to reduce income differentials between member countries also have strong reason to support such policies.

The macro-level benefits of slower population growth do not necessarily follow immediately upon such policies. For instance, significant alleviation of employment problems would follow a reduction of fertility with a time lag of only some 15-20 years. Even so, economic and political returns to investments in supporting population programmes, if such programmes are effective in moderating demographic growth, compare favourably with the returns expected from investments in many fields of conventional economic assistance.

#### Humanitarian and welfare considerations

Concern with poverty has always been an important motor force for international action involving unilateral resource transfers between nations. The earliest beginnings of foreign aid were ad hoc expressions of human solidarity towards victims of disasters, natural or man-made. Following the Second World War, in an increasing number of countries some of arguments of distributive justice that made the nation-state an engine of domestic income redistribution were extended to support systematic assistance to economically less developed countries. In enlisting domestic support for foreign assistance, humanitarian considerations for the welfare of the poor living outside the national boundaries continue to be stressed and have proven effective to a degree.

There are, however, crucial differences between domestic redistribution and international income transfers. Within States, modifications of the



patterns of primary income distribution through compulsory levies are the outcome of a participatory political process that creates individual entitlements and rights backed up by corresponding obligations that are enforced through appropriate institutions. Internationally, the corresponding element of participation is missing: decisions are made unilaterally by the donor State and reflect donor values and political judgements. In a further difference, domestic income transfers, although mediated by the State, are from individual to individual, assuring a pattern of benefits and sacrifices that are unambiguously linked to individual characteristics. International transfers are largely between sovereign States, with the donor exercising only limited control over ultimate use. This creates the virtual certainty that some of the individuals supporting the transfers as taxpayers are less well off than some of the recipients.

These characteristics have tended, first, to set fairly narrow limits to international assistance without a tangible quid pro quo. Transfers between States based on humanitarian concerns are a small fraction of the size of income flows generated by internal redistribution schemes. Indeed, much of the domestic debate concerning the socially desirable patterns of income distribution makes no reference to international differences between incomes, even though these differences are often far wider than differences within countries.

Second, foreign transfers predicated on humanitarian considerations, as distinct from development aid in general, tend to emphasize particular end uses in order to secure greater assurance that aid shall benefit the poorest segments of the recipient population. Among the types of aid seen as most effective in this respect, population assistance has ranked high: on a par with, or just below, health assistance or food distribution schemes. The concern with aiding the poor through population programmes springs to some extent from the notion of macro-economic gains expected from successful programmes: slowing down population growth should accelerate overall development, and this should benefit the poorest segments of the population. But the main focus of the humanitarian argument is on direct welfare assistance, especially the provision of goods and services to poor people who otherwise would not have access to such services; and on the attendant benefits accruing to particular groups, such as women and young children, in terms of greater freedom, better health or greater emotional and personal well-being.

The attitude of recipient Governments towards foreign assistance motivated by humanitarian considerations tends to be ambivalent. Such grants are seen as justified by existing international income differentials, and this interpretation accords well with the influential view that such differentials in and of themselves establish a moral claim for international transfers. On the other hand, in practice such aid necessarily carries strong paternalistic overtones and tends to create relationships of dependency rather than a partnership of equals based on the expectation of mutual gains from exchange.

To some extent, international institutions resolve the dilemma posed by these conflicting perspectives. They reallocate funds contributed by national Governments through grants that favour poor countries and that are more akin



to entitlements than to international charity. It is sometimes suggested that further development of such institutions should lead to a supranational authority with powers of taxation and endowed with redistributive functions analogous to those of nation-states.<sup>9/</sup> There is little evidence, however, that the international system is moving towards the degree of integration and solidarity that would be a necessary condition for the emergence of such an authority.

### Options for development

Discussions of the welfare implications of rapid population growth tend to be dominated by narrow economic considerations. In evaluating future economic gains, the usual reference point for comparisons is the current level of consumption, with tastes implicitly assumed constant. But development not only brings higher levels of income; it also changes preferences. Although it should be possible in every country to satisfy the basic needs of a much larger population, satisfaction of higher-level needs is likely to prove more difficult. As population increases, the range of developmental options available becomes narrower. One broad class of options concerns the preservation of desirable characteristics of the natural environment. The accommodation of large populations at high-income levels entails a steady accumulation of man-made artifacts, leading to the disappearance of certain environmental amenities. Ceteris paribus, increased population size in a given territory means reduced per capita availability of natural assets that are in fixed supply. The effect is amplified by economic growth, which tends to reduce the land areas not claimed by human habitation or by industry.

The consequences of such changes affect primarily the inhabitants of the country in which the changes take place, but there is also an international dimension to the problem. Even if the rate of use - current or prospective - of natural amenities by non-nationals is low, the increasing scarcity or outright destruction of such amenities does represent a loss to them. Most inhabitants of London or Cairo may never plan to visit unspoiled nature in the American West, or the foothills of the Himalayas, or the Amazon Basin. Significant psychic benefits are derived, however, from the simple awareness that such places exist and are potentially accessible. The narrowing of such options diminishes welfare.

Another class of relevant options concerns the conditions of contact with people living in countries other than one's own. One of the likely domestic implications of rapid population growth in any given country is greater governmental regulation of people's lives. Combined with the differences in national economic and social development, in turn caused partly by differential demographic growth, such a trend tends to reduce interaction with citizens of other countries. It is certain to contribute, for example, to the perpetuation of the system of nation-states. Despite the expected further advances in the ease of transport and communication that in effect diminish the size of the planet, "spaceship earth" is likely to remain effectively out of reach. It is not suggested, of course, that demographic factors necessarily have a dominant influence on the prevailing forms of domestic political organization and on the patterns of international intercourse; but



it would be clearly implausible to assume that development paths that would have been open to a world numbering, say, 3 billion persons - the world total in 1960 - will also be open to a population three or four times that size.

One option that is likely to be lost as a result of population growth is population growth itself. As noted above, the standard assumption concerning long-term demographic prospects posits the universal achievement of replacement-level fertility by 2000 or within a few decades thereafter. Thus, the feast of very rapid population growth in the second part of the twentieth century is to be replaced by the fast of no growth at all later. Although such a cessation of population growth is likely to be, on balance, highly desirable, the necessity to maintain a stationary population (presumably permitting only minor fluctuations around the zero-growth fertility level) will mean foregoing the obvious social amenities provided by a relatively young age distribution. The even greater amenity of parental freedom of choice concerning the number of children may also become a casualty of rapid demographic growth. It should be noted in this context that the nature of the social mechanisms that will be necessary to achieve and thereafter maintain replacement-level fertility is not at all clear. Indeed, the issue is not addressed in the literature presenting the projections. It is highly unlikely that the stipulated aggregate behaviour will be the fortuitous outcome of voluntary individual choices. Often, to make the projections at all plausible, an intrusive governmental role in shaping fertility decisions will have to be assumed.

#### Population policy responses

To what extent can population policies mitigate the problem of rapid demographic growth, and, in particular, what is the likely scope of international action in population policy matters during the coming decades? The potential role of two types of policies - relating to international migration and to mortality - would seem to be narrowly circumscribed. The prospects for useful action in the matter of fertility are more promising.

#### Policies concerning international migration

International migration changes the distribution of the population between nation-states. It can have an important effect on national growth rates but can affect aggregate growth on the world level only indirectly - through mortality and fertility. Quite likely, in the sending countries the indirect demographic effects generated by large-scale migration could be significant. In the short run, international migration tends to reduce mortality and increase fertility, thus increasing the rate of natural population growth. Still, the growth-reducing effect of out-migration is likely to be dominant: international migration can be an important safety valve relieving population pressures. In the receiving countries the main demographic effect of migration is, of course, to increase population growth.

The aggregate economic effect is also fairly straightforward. International migration, by bringing about a better adjustment of the world's



population to world economic resources, should result in a higher total world product. This potential economic effect is quite large. The existing distribution of the world population between countries is poorly related to relative resource endowments. For example, the current population of Southern and Eastern Asia represents 50 per cent of the estimated total world population. Yet the area occupied by this population possesses only 16.5 per cent of the world's total energy resources.<sup>10/</sup> If China is excluded, the contrast is even more pronounced: 30 per cent of the world population possesses 3.2 per cent of estimated total energy resources. Prospective demographic trends are likely further to increase such inequalities with respect to the natural-resource base. The distribution of man-made physical productive assets and of human capital shows equally sharp inequalities.

If there were no barriers to the international movement of people, it is virtually certain that the existing great differences in factor endowments would generate massive migration flows, significantly affecting relative demographic and economic characteristics of many nations. Disregarding the complicated issue of the brain drain (which, in any event, is not usefully discussed as a population policy matter), the economic effects, in terms of changes in income per head, would be generally beneficial both for the sending and the receiving countries. However, in the receiving countries the competition created by migrants would tend to reduce the relative income shares accruing to labour and, quite possibly, absolute wage levels in less-skilled occupations as well.

There are, of course, heroic simplifications lurking behind these bland propositions, rendering them largely meaningless. Thus, for example, large-scale immigration might generate cultural and political tensions that would drastically reduce the real and perceived economic advantages both for immigrants and for the receiving country. But the point is academic. International migration is not free; hence its current volume, while large by most historical standards, is insignificant by comparison with the net annual increase of the world population. National policies in most countries that would be potentially attractive destination points for international migrants either completely bar entry to foreigners for permanent settlement or keep such movements within narrow limits.

Policies of socialist States, of course, are uniformly in the first category. The logic of comprehensive state planning is clearly hostile to movements of labour across frontiers, even to and from States with similar economic and political arrangements. The Chinese-Soviet border, for example, marks one of the sharpest gradients between neighbouring States as regards population-to-resource ratios. There is, of course, no significant migration across that frontier now, but even at the time of Chinese-Soviet amity, there was no expectation that such movements would materialize in the future.

A strictly enforced stance against permanent labour migration is not the exclusive property of socialist States. Japan is an outstanding example of a market economy that follows such a policy. Judging from the tone of recent policy discussions concerning migration, the majority of Western European States are also moving in that direction as far as migration from outside the European Economic Community is concerned. Any return to the more liberal



attitudes that characterized European migration policies during the early post-war decades is expected to be partial, limited to labour movements under term contracts. Owing to low fertility in the past, a return to economic buoyancy may of course recreate a situation of acute labour shortages in Western Europe. (For example, between 1990 and 2000 the size of the population between ages 20 and 40 will decrease by more than 4 million.) But emerging technological trends suggest that, through automation, the demand for labour could be significantly reduced. More importantly, in future decisions concerning immigration policy, social rather than economic considerations are likely to be increasingly influential. This will tend to favour restrictive policies.

In the United States, which remains the most important country of immigration, the direction and the outcome of the current debate on immigration policy is less easily predictable. The seeming confusion of that debate reflects not only the conflicting economic interests involved, but also the fact that the size of what is probably the largest component of United States immigration - illegal immigration - can be estimated only within very broad limits. It is reasonable to assume, however, that, as in Europe, non-economic considerations will be given increasing weight in determining policy. Since concern about the social impact of immigration tends to increase disproportionately beyond some threshold level of the number of recent migrants, public resistance to the costly and onerous measures that would be required to enforce the existing immigration laws is likely to weaken in the future. Since those laws - now easily flouted - are fairly restrictive and are likely to remain so, such a development would tend to reduce immigration to the United States substantially.

It seems safe to conclude that in the coming decades international migration policies are not likely to make a significant contribution to the solution of problems caused by rapid population growth. Proposals for radical new initiatives towards population redistribution across international frontiers - e.g., through transfer of administrative control (but not sovereignty) over designated territories from one State to another for purposes of colonization - seem to lack realism.<sup>11/</sup>

### Policies affecting mortality

Levels of mortality are a major factor in influencing rates of population growth. The rapid reduction of death rates in the developing world since the Second World War (to a significant degree achieved through health policies supported by foreign assistance) was the primary cause of the "population explosion". Since third world mortality levels are still significantly above those achieved in the economically advanced countries, much further improvement is still possible. To the extent that such improvement is realized, population growth rates will increase. It has often been suggested that lowering infant and childhood mortality will contribute to reduced fertility, compensating for the initial growth-promoting effect. The scientific debate on this issue is not fully resolved, but, on balance, the evidence does not confirm that such compensation in fact takes place.<sup>12/</sup> However, past decisions concerning health policies, including decisions on



international assistance aimed at reducing instability, were not influenced by the expected impact on population growth. In view of the overriding value of health in its own right, it is unlikely that policy-makers will take a different stance in the future. Insofar as rapid population growth is deemed socially undesirable, there is a sound consensus that the full burden of adjustment ought to be placed on fertility.

### Policies affecting fertility

Government efforts in the developing countries aimed at reducing population growth through the reduction of fertility have received much international attention during the past two decades. The policy approaches have been thoroughly debated and widely publicized. Only the briefest reminder of the contending viewpoints need be given here to serve as a background to the issue at hand: the expected international dimension of such fertility-reducing policies during the coming decades.

By way of a rather drastic simplification, two main positions concerning fertility policy may be distinguished. The first sees high levels of fertility as an aberration that reflects the inability of potential parents to apply efficient birth-preventing measures, either because of ignorance or because of the high cost of acquiring the needed services. In this view, a large proportion of parents in high-fertility countries desire no more children than they already have; indeed, some of their existing children have resulted from pregnancies that were unwanted. The policy prescription corresponding to this diagnosis is straightforward. Programmes are to be organized to inform people about birth control techniques, and subsidized (or preferably free) services are to be offered providing access to efficient contraceptive technology.

The other position explains high fertility as a fairly accurate expression of prevailing parental preferences for children. These preferences are seen as deeply rooted in parents' emotional needs and are strongly supported by cultural norms. Fertility behaviour also reflects, inter alia, children's positive economic contribution to productive activities of the family and their insurance value as old-age support for parents. According to this view, in order to achieve a decline in fertility, policies must change the social and economic arrangements that bear on parental reproductive behaviour. Access to improved contraceptive technology is a factor in shaping that behaviour; but, in and by itself, it is unlikely to be a significant one.

Under conditions of rapid socio-economic change, the programmatic implications of these two positions need not be contradictory. One result of such a change will be the emergence of increasing demand for birth control. Family planning programmes can cater to that demand by providing access to contraceptive technology and by reducing the costs of its adoption. The question of the relative importance of the causal factors is moot: the aim is to ease the onset of fertility decline and accelerate its pace.

Not surprisingly, strong international support for such programmes has been forthcoming. The improved contraceptive methods that became available in



the 1960s were a natural candidate for organized technology transfer: they were new, relatively inexpensive and manufactured only in the developed countries. Voluntary acceptance of birth control services certifies that programme clients derive a personal benefit from their participation while at the same time contributing to the social objective of the programmes: reduction of the rate of population growth. Thus, harmony of individual and collective interests tends to make such programmes politically non-controversial, and hence a natural choice for favoured treatment in foreign assistance programmes.

Family planning programmes have performed well in the relatively advanced developing countries, but not so in situations of economic backwardness and slow social change. Under such conditions, available remedies for the problem of rapid population growth are more painful and difficult. The policy remedies are of two distinct types, although in practice they tend to be jointly applied. First, Governments may seek to overrule individual reproductive motivations and demand conformity to socially determined rules concerning proper fertility behaviour. The Chinese objective of reducing the size of all families to no more than two children - and even pressing for the adoption of the single-child norm - is an extreme example of policies of this type. Second, as part of the overall design of development policy (which under conditions of backwardness may aim at a radical restructuring of social institutions), demographic considerations can be explicitly recognized. Thus, when a reduction of population growth is a social desideratum, development policy may be given a bias that creates micro-level pressures favouring the adoption of low fertility. Once again, the policies pursued by China provide the most apposite reference.

It can be readily appreciated that neither of these lines of attack on socially objectionable patterns of fertility behaviour offers a large scope for international assistance, let alone for close foreign involvement in policy execution. To promote such policies, there are no tangible goods that can be helpfully transmitted from donor to recipient: the "technology" of new institutional design is necessarily home-grown. Even when foreign assistance could be helpful, political considerations tend to dictate reticence either in accepting or in offering it. Outsiders' judgements on human rights matters are bound to differ from domestic interpretations.

Significant international involvement in fertility policies is likely therefore to continue to be limited to assistance in the relatively non-controversial field of family planning programmes. Given the large numbers of people who are potential clients of family planning programmes, such assistance could grow rapidly as fertility decline spreads to more and more countries. Developing countries experiencing fertility decline are likely to be economically the most successful ones. Such countries are likely to be increasingly able and willing to finance domestic service programmes whenever such programmes are demanded by the population. Domestic willingness fully to underwrite the costs of family planning programmes is likely to be more than matched by donor reluctance to extend assistance indefinitely. In the "difficult" countries, international population assistance will continue to have limited scope, at least until a large-scale demand for family planning services emerges. International attention will have to focus, instead, on



creating the economic and social preconditions of fertility decline. In such situations, the issue of population policy merges with the broader issue of development policy. To discuss that vast subject is outside the scope of the present paper.

### Prospects for population growth

The magnitude of the international problem of rapid population growth, and its hold on the attention of policy-makers in the coming decades, depend mainly on future fertility trends. On this score, the message implicit in present global projections is, in part, discouraging. It illustrates the momentum of population growth: in the developing world, further rapid demographic increase in the 1980s and 1990s is a virtual certainty. The confidently expected speedy and universal convergence of the projections to replacement-level fertility anticipated during the coming decades, in contrast, has a soothing effect, since it implies a rapid decline of demographic growth by the early 2000s. In recent years, this prospect of quasi-automatic decline has come to dominate discussions of population issues. But, in fact, no claim can be made that such convergence is assured or even highly probable. Numerous features of the contemporary demographic situation could be cited to demonstrate this point. Sixty years of socialist rule have left the fertility of the Muslim populations of the Union of Soviet Socialist Republics virtually unchanged. In 1980, World Bank projections anticipated that Iran's population would stabilize at 102 million; in 1981 the figure was changed to 140 million, presumably to reflect the hostility of the new regime towards family planning. (In 1982 the estimate was again reduced, to 119 million.) In sub-Sahara Africa and in much of South Asia, fertility decline has not yet begun, and no solid theory explains why it should start tomorrow. If the past is a guide to the future, a significant reversal of recent Chinese fertility trends is by no means impossible. There is, of course, a broad negative correlation between levels of "development" and levels of fertility, and this does suggest that successful development eventually would reduce population growth. But such correlations do not rule out the possibility that in many developing countries a significant portion of future increases in income and in food production will continue to be used simply to sustain further demographic expansion - expansion at rates of growth that would be somewhat more moderate than are present rates but that nevertheless would generate absolute accretions to population numbers that are extraordinarily high by historical standards and that act as a break on the very process of economic improvement expected to reduce population growth.

Indeed, in the absence of purposeful action that would succeed in reducing fertility far below the level implied by uninterfered-with parental choices, such continuing growth for a long period to come is the most likely prospect for mankind. It was at one time widely believed that emerging Malthusian pressures set a relatively low ceiling on long-term demographic growth. Thus, for example, when India's population was 350 million and China's 500 million, significant growth in these countries beyond, say, 700 million or 1 billion seemed improbable to most informed observers. With the benefit of hindsight we know that the economic slack inherent in the exploitable potential of existing and emerging agricultural and industrial technology has been consistently underestimated.



The myopia exhibited by so many past predictions concerning long-term population growth prospects should caution against confidence in the rapid march towards a stationary world population uniformly depicted by current population projections. The classic Malthusian mechanism of increasing resource constraints as the regulator of population growth is likely to remain inoperative for many decades to come in much of the developing world, and no equivalent alternative mechanism leading to population stabilization in the foreseeable future in today's developing countries has been identified. As long as part of the realized economic growth potential is allocated to provide at least a modicum of improvement for the majority of the populations now living in poverty, and as long as economic growth permits the relatively thin (if slowly expanding) layer of the ruling technological-political elites of the developing countries to enjoy material standards of living increasingly resembling those prevailing in the developed world, a "population crisis" can be indefinitely postponed. But such success will be achieved at the high price of reinforcing many of the negative tendencies now discernible in the dynamics of the international system outlined in this paper. As the ratchet of technology lifts global numbers to higher and higher levels, the prospect of a unified world society whose citizens either already enjoy high levels of living (as defined by criteria of material consumption, freedom of movement and political liberties) or can have realistic expectations of attaining such levels will fade, and antagonisms between States or groups of States seeking to protect the relatively privileged status enjoyed by their own citizenry or staking out claims on the rest of the world in the name of distributive justice will increase. Unless population policies succeed in bringing about demographic trends that track projections leading to early attainment of a stationary world population reasonably closely, these tendencies will represent a growing danger to mankind's future.

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5/ When such forecasts are made, disagreement is apt to be vocal. The dominant negative reaction of economists to The Limits of Growth report is epitomized in Carl Kaysen, "The computer that printed W\*O\*L\*F", Foreign Affairs, vol. 50 (1972), pp. 660-668. More recently, the massive United States Government study, The Global 2000 Report to the President, elicited equally harsh dissent despite its more guarded formulations. The titles of two reviews are indicative: Julian Simon characterized the Report as "Global Confusion, 1980", in The Public Interest (Winter 1981); more succinctly, Herman Kahn termed it "Globaloney", in Policy Review (Spring 1981).

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9/ The most recent proposal for such a plan is put forward in the Brandt Commission Report: North-South: A Program for Survival (Cambridge, Mass., MIT Press, 1980).

10/ Roger Revelle, "Economic dilemmas in Asia: The needs for research and development", Science, vol. 209 (4 July 1980), pp. 164-174.

11/ See, for example, Alfred Sauvy, La question de l'espace et la population sous l'angle de la solidarite, Serie de Recherche No. 36, (Geneva, Institute International d'Etudes Sociales, 1978). Sauvy's examples for ceding administrative control through "treaties of solidarity" include Australia, France and the United States, on the one hand, and Mexico, the Maghreb and Southeast Asia, on the other hand.

12/ Samuel H. Preston (ed.), The Effects of Infant and Child Mortality on Fertility (New York, Academic Press, 1978).







B. Choice of alternative paths to a stationary population:  
some economic considerations

Timothy King\*

No country can have its population grow for ever - the world has fixed dimensions. For several years the World Bank has published projections which extend out to a point at which the population is assumed to become stationary. This is done somewhat sheepishly, with a recognition of how enormous the range is of possible demographic outcomes, and how uncertain the timing of such an event; neither a crystal ball nor a sophisticated forecasting model is claimed for selecting one of these outcomes for every country. These projections are made in a stylized way, almost deliberately to call attention to their hypothetical nature. It is assumed that with sufficient levels of economic development, fertility will universally decline to replacement; there are more than ample precedents for this. Second, it is assumed that countries whose current fertility is below replacement will find ways to increase it, rather than see their populations die out altogether; this seems reasonable, even if the mechanisms are far from clear. Third, once attained, it is assumed that replacement level fertility is maintained. This is quite contrary to historical precedent but it is simpler, and no less plausible, than any single assumption about the way in which fertility might fluctuate about replacement. In spite of their limitations, the projections are issued as a reminder that a roughly stationary population must be the long-run demographic situation of every country, and that this must not be thought to be something impossibly remote in time. For all developing countries, the most crucial step, the initial attainment of replacement level fertility, is projected as occurring between the years 2000 and 2045 - that is within the lifetime of those born today, even in the least-developed, highest fertility countries.

The purpose of this paper is to discuss some of the considerations that should influence the choice of a path to replacement, which of course will also largely determine the stationary size of the population.<sup>1/</sup> Such considerations are rightly remote from the concerns of most developing countries, whose principal object of population policy is, or ought to be, how to initiate, maintain or accelerate fertility decline. This is the case even for most of the countries where a sustained decline in fertility is clearly under way. But as fertility begins to approach replacement levels another set of questions start to assume interest. To what extent should fertility be encouraged to drop below replacement in an effort to reduce population growth to zero, or even to reduce population size? What are the economic and social implications of the changes in demographic structure that have already resulted from the fall in fertility and that can be predicted to occur as low fertility is maintained for the indefinite future?

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\* Chief, Employment and Income Distribution Division, Development Research Department, World Bank. The opinion are those of the author and do not necessarily reflect those of the World Bank.



These questions are of particular importance where the fall in fertility has resulted from vigorous anti-natalist policies, such as economic rewards to couples who restrict their family size to one or two children, or penalties on large families, such as additional taxes for the third and later children. What would be the demographic and economic consequences of withdrawing such policies? Would people be confused and possibly cheated by an apparent change in fertility norms? To judge from the handful of cases where economic incentives and disincentives have been important elements of population policy - such as in China, the Republic of Korea, and Singapore - these measures seem typically to be imposed at a relatively late stage in the fall in fertility, perhaps because it is only then that their social and political acceptability is clear. A Government may be reluctant to appear to change course only a few years later, especially since at the time when replacement fertility is reached, population will still be growing and appear likely to do so for several more decades.

Although these issues appear of immediate relevance only to the small number of developing countries whose current total fertility rates are below 3.0, it is likely that over the next decade several more countries in Asia and Latin America will begin to face similar issues. In any case, the inclusion of China among these countries means that these matters are of importance to a significant fraction of the population of the developing world. This paper will confine its illustrations to the Chinese example. The abrupt nature of its recent fall in fertility brings certain questions into sharp relief, while the demonstrated ability of the Government of China to impose a remarkable degree of social control over individual fertility decisions makes the policy questions to be considered highly relevant to the country's present situation. Moreover, since the Chinese population is more than one fifth of the human race, decisions that the Government makes about population policy may make a great deal of difference to the eventual size of the world's population.

This paper will consider only the economic implications of alternative patterns of population growth. Obviously, the choice of population policy cannot be made on economic grounds alone. Other dimensions of the quality of life must be considered, as well as the ethical and political acceptability of the means needed to achieve any particular outcome. The neglect of such questions in this paper is in no way intended to downplay their importance. Indeed, since like so many discussions of the consequences of alternative patterns of population growth, the economic analysis proves somewhat inconclusive, this paper may be held to emphasize the critical role that non-economic considerations might play in the choice of policy. But inconclusiveness does not mean insignificance and, as will be illustrated, fairly small changes in demographic assumptions may have a very marked effect on the eventual size of a population and hence on the whole economy.

#### The economic analysis of alternative projections

In analysing the implications of alternative demographic situations, it is useful to distinguish issues concerning (a) ultimate population size; (b) the rate and direction of change in total population; (c) the changing age composition of the population; and (d) the distribution of income and output.



### Ultimate size

The size of a country's stationary population and the actual or potential pressure exerted on fixed supplies of natural resources will be one factor - but only one among many - determining eventual living standards. This size will be determined partly by the date at which a steady replacement level of fertility is reached, and partly by the path taken to get there. In very densely populated countries the question of size may be the most important issue of all. But if this is the case, then it usually reflects a grim situation - one in which the analyst is forced to ask how many people the country can support at a minimum standard of living, given the possibilities for international trade and accumulation of both human and physical capital. Put in this way, however, the question is almost impossible to answer. At the very minimum, it needs to be fixed in some time dimension, for otherwise it is reasonable to assume that technological possibilities are limited only by the laws of physics. Even where the data of attaining the ultimate size is specified, it is usually realistic to assume that it is far enough ahead to permit most current technological constraints to be assumed away, and perhaps also to permit one to assume a radical change in the structure of international trade, so that the production within densely populated countries can greatly reduce its current dependence on land or other natural resources.

For most countries it is reasonable to assume that the issue will not be posed in terms of how many people can subsist, but how many can enjoy a comfortable standard of living. This severs the question entirely from its physical and biological basis and makes it still less easy to answer.

### Rates of change of total population

For most countries this is likely to be a question that can be more readily analyzed than issues of ultimate size, but nevertheless it is not something that is likely to prove of great significance in choosing between one demographic path and another. The reason is that once a situation of low fertility is reached, the rate of population growth, though still positive, is almost certain to be low compared to historical rates of economic growth. The difference in population growth rates under alternative paths is unlikely to be greater than 1 per cent (unless one of the paths shows a negative growth rate). This is far outweighed by possible differences in economic growth rates.

### Changes in the age composition of population

The exact age composition of a stationary population will depend on the pattern of mortality, but it is reasonable to expect that the proportion of the population over the age of 65 will be of the order of 20 per cent or more. Even though the increase in the burden of old-age dependency that this entails (compared with contemporary levels) is to some extent offset by a reduction in youth dependency, the problems associated with elderly dependency are greater. In the first place expenditures for an elderly person are



generally greater than for children. A review of several studies of age profiles of consumption suggests that attributing to children under 15 an expenditure equivalent to 0.5 adults, and to people of 65 and over an expenditure of 0.9, would be consistent with observed patterns.<sup>2/</sup> In many circumstances this appears to be true even when taking into account educational needs, at least at the primary level.<sup>3/</sup> There is, however, no unambiguous way to measure children's consumption needs as a proportion of adult levels; there are still conceptual difficulties and they obviously differ with income and size of family.<sup>4/</sup> Second, the problem of transferring resources from one group of the population to another is potentially more serious. The main support for children comes directly and in most cases solely from parents; except for education, it does not require special institutions or taxation, or transfers outside the household. In contrast, the elderly are likely to remain in separate households, and may be limited in the extent to which they can rely on the support of their (relatively few) children. In consequence the potential transfer burden becomes a more serious one.

The change in age composition is achieved by changing relative rates of growth of different age cohorts. If fertility has been falling fast enough, there may be quite sharp changes in the size of different cohorts, and for important age groups, such as the school-age population, growth can easily be negative. Unfortunately, while population growth imposes costs on a society by requiring resources to maintain per capita levels of physical and human capital, the resources freed by population decline may be fixed in form and have little value in alternative cases. A rapid decline in the school age population, for example, may free classrooms, but there may be little alternative uses for them. It may also be harder to get an aging, already-trained labour force to adapt to the demands of technical change.

### Distributional issues

Changes in age composition also have distributional effects since alternative patterns of population growth have very different economic consequences for different groups and generations. A different pattern of population growth will affect the relative welfare of the families which may or may not have another child; it will affect their local communities, and taxpayers more generally, who may or may not have to finance public services. The size of a cohort will affect the employment and earnings possibilities of its individual members, and its relative position vis-à-vis earlier and later cohorts. The relative size of different generations will affect their potential ability to save, and their ability to provide for the retired population. The total size and demographic composition of the population affects the pattern of demand, which affects the distribution of resources and incomes between different sectors of production and areas of the country. In sum, in the long term, demographic events play a very important and complex role in determining the pattern of output and its use by different parts of the community. The practical magnitude of individual efforts can vary enormously, however, and many are relatively distant in time; it is often not easy to predict the net result.



These are all very general effects, not easily measurable under any circumstances. The discussion of a specific example, as now follows for China, can at least give some idea of their likely relative degree of importance in an actual situation.

### The Chinese example

#### Recent population growth

For many years, China was a large blank space on the global population map. In the last three years, however, large amounts of demographic information have become available, and the blank space can now be filled in, at least in outline. The preliminary results of the 1982 census are an important part of this information, but more data from the earlier censuses of 1953 and 1964 and a time series of birth and death rates have also been among the data to be recently published. There nevertheless remain substantial limitations in our knowledge. The data have a variety of origins, and apparently have had to be reconstructed for some periods of statistical lapses. The Chinese authorities acknowledge that the information is not all internally consistent.

There are also some conspicuous gaps. No population totals have been released for the period 1958-1963. This was a period that experienced considerable economic and social disruption during the Great Leap Forward (1958-1959) and economic collapse during the grim period of floods, droughts and famine which followed during 1959-1961. Official estimates of vital rates during this period show birth rates falling from 34 in 1958 to 18 in 1961 and then rebounding to over 43 in 1963, while death rates moved in the opposite direction, from 10.8 in 1958 to 25.4 in 1960, falling back to 10.1 in 1962. These demographic events are of more than historical interest, since this was the birth period of the cohorts now reaching or about to reach marriageable age. There also exists little information on regional and local differences, which in a country of such size and heterogeneity are bound to be important. The full results of the recent census should eventually provide substantial further clarification of the demographic situation.

The gaps and discrepancies among different sources of information force the analyst into producing estimates of his own. Table 1 has been estimated by Kenneth Hill as a consultant to the World Bank, using primarily information from the 1953, 1964 and 1982 censuses, and data on the age distribution in 1975 from a national cancer survey.<sup>5/</sup> Except for the 1958-1962 period, Chinese demographic experience in the 1950s and 1960s was not very different from that of many other developing countries in Asia or elsewhere. Fertility appears to have remained high with little change (apart from the famine years) until the late 1960s. Since then it has fallen at a quite extraordinarily rapid pace. In contrast, mortality has shown a steady, rapid improvement throughout the entire period since 1950 (except for the famine years).<sup>6/</sup>



Table 1. China - estimates of population growth, fertility and mortality, 1950-1982

Year	Mid-year population (millions)	Birth rate (per thousand)	Death rate (per thousand)	Rate of natural increase (per cent per year)	Total fert- ility rate (live births per thousand)
1950	576.3	43.8	27.3	1.65	6.2
1951	586.4	45.4	27.0	1.84	6.4
1952	598.2	47.8	26.6	2.12	6.8
1953	611.1	47.7	26.2	2.15	6.8
1954	624.7	48.4	25.9	2.25	6.8
1955	638.1	46.2	25.6	2.06	6.7
1956	651.0	44.2	24.6	1.96	6.5
1957	665.0	45.5	22.8	2.27	6.8
1958	677.8	39.5	24.0	1.55	5.9
1959	684.8	32.0	27.0	0.50	4.8
1960	683.4	24.8	34.0	-0.92	3.7
1961	680.2	26.0	26.0	0.00	4.0
1962	685.7	39.0	23.0	1.60	6.0
1963	700.2	44.5	18.5	2.60	6.8
1964	717.7	43.0	19.6	2.34	6.6
1965	735.7	42.8	16.0	2.68	6.6
1966	755.0	39.6	14.4	2.52	6.2
1967	774.3	38.4	13.0	2.54	6.0
1968	795.4	40.2	11.8	2.84	6.3
1969	817.7	37.2	10.5	2.67	5.8
1970	838.9	34.1	9.8	2.43	5.3
1971	858.6	31.5	9.4	2.21	4.8
1972	877.1	30.3	9.8	2.05	4.6
1973	894.7	28.3	9.1	1.92	4.3
1974	910.4	25.1	9.5	1.56	3.8
1975	924.0	23.2	9.4	1.38	3.3
1976	936.0	21.3	9.3	1.20	2.9
1977	947.0	20.3	8.9	1.14	2.8
1978	957.9	19.6	8.1	1.15	2.7
1979	968.9	19.1	7.9	1.12	2.6
1980	979.6	18.5	7.9	1.06	2.5
1981	991.3	20.9	7.8	1.31	2.9
1982	1008.2				

Source: World Bank estimates.



## Population policies

The policy measures which brought about the fall in fertility are of course highly interesting in their own right, but a detailed discussion is outside the scope of this paper.<sup>7/</sup> A brief description of population policies is, however, valuable to underline that the dominant forces in recent fertility decline have indeed been national population policy and social pressures rather than individual preferences, and to indicate who bears the cost of current policies and who is likely to benefit from them. The choice among alternative demographic paths should ideally consider not only the relative desirability of alternative demographic outcomes, but also the relative costs of achieving them. This issue, however, is only lightly touched on in this paper.

China began its first family planning campaign in the mid-1950s, but this was abandoned during the Great Leap Forward of 1958. A second campaign began in 1962, but was swept aside by the Cultural Revolution. Only its efforts since 1971 seem to have had any significant demographic impact. Since 1971 birth planning has been considered as an integral part of other social and economic planning. Individuals have been expected to conform voluntarily to established social norms of reproductive behaviour - summarized as later marriages, longer birth intervals and fewer children - once their basis has been explained and understood. But, just as with productivity, recent policies have stressed the need for individual incentives as well as mere acceptance of social goals, so that economic and social incentives for smaller families and disincentives to large ones, established and financed on a local basis, have increasingly been permitted and encouraged.

Policies adopted in 1971 led to the establishment of a hierarchy of birth planning institutions and individuals. This was headed by the "Birth Planning Leading Group". Since 1981, it has been run by the State Family Planning Commission, which reports to the State Council, and there are corresponding committees at each governmental level down to the production brigade or its urban equivalent. Since the mid-1970s, a national target population growth rate has been translated into a maximum rate of natural increase allowed for each province, taking into account the level of development and ethnicity (minority areas are permitted higher birth rates). In turn (at least in principle) the province provides each county with a birth quota, the county allocates this among communes, and so on down to the level of production teams or urban residential units which assign permission to individuals to have children. At this level, the implementation of policies are reinforced by part-time family planning workers. Contraceptives and surgical services are supplied freely through the health system.

This description probably implies too much of a top-down process. There has clearly been a good deal of local participation in the establishment of local targets. At present more emphasis seems to be given to approving the plans of individual and lower-level units to see that they conform reasonably well to the norms of the one-child family policy (established in 1979), or its permitted exceptions, than to imposing an external target on local groups. Women who marry at 23 or later seem normally to be allowed to have one child

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as soon as they wish but must then be strongly discouraged from having a second. Those who marry earlier than 23 may be discouraged from having a child immediately. The extensive network of work and residential groups, established to study and discuss economic and social issues and policy, has facilitated the mobilization of peer pressures on couples to accept community birth planning decisions. The virtual absence of migration possibilities and the collective nature of income distribution must, in rural areas at least, have provided a real sense of the social interest at stake in individual fertility decisions, and must have encouraged the community to take the task of collective birth planning seriously. Such groups could also be harnessed to discourage marriage until the age of 28 and 25 for men and women respectively in cities, and 25 and 23 in rural areas. Sometimes individual local governments promulgated regulation to enforce such marriage ages, but these were rendered void by the 1980 marriage law which has set a minimum age of 20 for women and 22 for men.

To summarize the achievements of the 1970s, it can be said that the birth planning programme was remarkably successful in achieving its objectives, partly by providing an efficient network of contraceptive services through the already extensive health system, but mainly by the unabashed use of moral suasion and social pressure on individuals to raise the age of marriage and reduce marital fertility. By these means fertility was brought down sharply; it appeared to be heading steadily towards replacement by the late 1970s.

Though impressive, these successes began to appear insufficient to Chinese policy-makers. The population continued to grow. Food output per head was little higher in 1977 than it had been in 1957. Looking ahead to the 1980s, the cohorts born in the high fertility years beginning in 1962 would be reaching marriageable age. So in 1979 a national policy designed to persuade married couples to have no more than one child was introduced. This policy was backed by a system of economic rewards to parents who agreed to have no more than one child, and penalties for those who persisted in having more than two. These are mainly financed by work units - those of the father and the mother are expected to share equally - and there is therefore considerable local variation in the rewards. However, a typical package offers a single child an allowance, often described as health-care subsidies, of 60 yuan per in urban areas <sup>8/</sup> and some equivalent allowance in rural areas, until the child is 14. Preferential treatment will be given in the allocation of urban housing and the same space given to the family with one child and two children. An only child may be given adult rations and count as 1.5 or 2 persons in the allocation of private plots. Maternity leave benefits are more generous for the first child. Parents are promised that an only child will get priority in educational admissions and employment assignments; that special physical checks will be provided by hospitals; that special events may be offered for only children; and that there will be a guarantee of their own relative living standards when they become old or widowed.

Penalties for excessive fertility also vary. Couples who have a second child must return any bonuses obtained for the first child. In some areas there may be other disincentives - for example, a couple having a second child may be required to pay a large amount for the privilege. Of course, second children may be permitted for a special reason - for example because



the first child was defective. Grain for a second child born outside the plan may in some localities have to be purchased at a higher price - in others this may be a penalty only on third and later children. Additional penalties on the third child are likely to include a tax of 5-10 per cent of income, and an elimination of medical and maternity leave benefits.

Attempts are being made to eliminate any pronatalism within the system that allocates resources or benefits to individual households, which in the past have often been on a per capita basis. Of particular importance is the allocation of land, especially under the recently established "responsibility systems" which make the household, rather than the team, the beneficiary of higher output. A recent article complained that in some areas farmland was distributed solely on a per capita basis and that this was having an adverse effect on family planning efforts.<sup>9/</sup> Official policy, however, is that family planning should be explicitly linked to the adoption of a production responsibility system and in some places contracts between a household and the team specify agreement about both production and childbearing.<sup>10/</sup> Failure to meet either target results in a substantial fine.

#### The demographic effects of recent policy

Initially this new policy appeared to have a marked effect. The proportion of births that were first or second order was reported to be 70 per cent in 1978 <sup>11/</sup> and to have risen to about 80 per cent in 1980.<sup>12/</sup> It is clear, however, that the policy took much firmer hold in some regions than others. The proportion of third births was less than 5 per cent in the major cities and 5-10 per cent in several provinces, but was around 40 per cent in some areas. In general, the less developed provinces (as measured by indicators of per capita income and the proportion urban) had a higher rate of births of second and later parities. Scattered data also suggest substantial regional variation in the proportion of eligible couples who had received one-child certificates. In 1980 several provinces, including the two largest, Sichuan and Shandong, reported that about 80 per cent of eligible couples had received certificates. In contrast, in Gansu and Guangdong the proportions were 26 and 29 per cent respectively.

In 1981 the policy suffered some setbacks. The birth rate appears to have risen - from probably a little over 18 in 1980 (no official birth rate has been published) to 20.9. At least in part this reflects a once-for-all rise in the number of marriages as a consequence of the 1980 marriage law.<sup>13/</sup>

Since it is generally accepted that premarital pregnancy is rare in China, a rise in the number of marriages can have only a limited impact in the year in which it takes place. It is also likely that in 1981 there was some reduction in the success of the one-child policy. This has been frequently and widely attributed to the widespread introduction of responsibility systems in agriculture, which make household incomes much more directly dependent on the output of household members (compared with those of the production team) than before.<sup>14/</sup> Since the allocation of land under the production responsibility system is - in many areas at least - not a once-and-for-all affair, many peasants may feel that larger families will entitle them to more



land. Some parents may view the potential contribution of children to family income as a reason for wanting more of them.<sup>15/</sup> Parents continue to see children, especially sons, as a source of possible support in disability or old age, especially if the effect of the responsibility system is to reduce collective welfare funds. The responsibility system has raised incomes, and it has made it easier to afford having children. With higher incomes, the economic incentives offered to a one-child family have also become relatively less attractive.

It is also possible that, at least in some areas, family planning efforts have slackened. For example, it has proved difficult for many brigades to retain barefoot doctors and these have often returned to full time farming, now made more lucrative by the responsibility system. It has also been reported that the reduction in collective funds has caused some brigades to abolish the brigade level women's work cadre, which had previously been responsible for the birth planning activities of the brigade and for supervising the family planning activities of the barefoot doctors.

In sum, the new policies have suffered from the fact that they represent an attempt to increase centralized social control in one field, while trying to reduce such control in others. It is clear that in spite of the Government's proven ability to influence fertility, there are limitations on this even in China, and it is therefore misleading to believe that fertility is totally or instantaneously under government control. Nevertheless, fertility is remarkably low for a country at China's level of development and the degree of social control to which it is subject is unprecedented.

#### Current demographic targets

The authorities acknowledge that it is unrealistic to expect every couple to have only one child. A family planning directive of March 1982 states that in urban areas couples should have only one child "except for extraordinary circumstances". It recognizes that in minority areas and in some other rural areas this policy may not be practicable, and those who show "a real need" for a second child may receive approval to plan for one. But in no circumstances should couples have a third child.

The officially declared demographic target is 1.2 billion people in the year 2000. This, the Chinese estimate, could be achieved with an average family size which drops to 1.7 per couple around 1985 and is then maintained to the end of the century. Table 2 shows that such a projection is consistent with the demographic estimates of this report.<sup>16/</sup> In table 2, the total fertility rate (TFR) is assumed to drop from an average of 2.3 in 1980-1985 to 1.7 after 1985. Mortality is assumed to continue to fall, but bearing in mind its already low level, only at a slow rate.<sup>17/</sup> (This is projection B, table 2.)

Given the successes of the Chinese population policy to date, this target appears to be attainable. Indeed it permits much more slippage from the target of one child per family than the authorities appear to be tolerating. If the number of three-child parities is kept insignificant, the majority of



Table 2. Projected birth and death rates to the year 2000, to match official targets

	Total population (mid-year) (millions)	B		Total fertility rate (5-year average)	Life expectation at birth
		Birth rate (per thousand)	Death rate		
1980	979.6	18.8	5.8	2.3	70.6
1985	1045.0	15.0	5.9	1.7	71.6
1990	1093.6	15.8	6.3	1.7	72.5
1995	1146.7	15.1	6.7	1.7	73.2
2000	1195.6				



couples could have two children, rather than one. Alternatively, a relatively vigorous application of policy could reduce the size of the year 2000 population significantly below 1.2 billion. For example, if the TFR were to be reduced to an average of 2.0 during 1980-1985, and 1.5 thereafter (which would still permit about half of all couples to have two children) the population in 2000 would be 1.17 billion. (This is projection C in table 3.) It is also interesting to compare these projections with one showing comparatively slow fertility reduction in a TFR of 2.4 in 1980-1985 declining to replacement in 2000-2005. This is projection A in table 3.

Since neither A nor C can be regarded as in any way extreme assumptions, the difference of nearly 115 million in population in 2000 is striking. But though very large in absolute terms and by the standards of other countries, it represents a difference of less than 10 per cent of the smaller figure. The difference in the average annual growth rate of population is only 0.5 per cent.

Although at least one group of Chinese authors have proposed 600-700 million as a long-run optimum population for China,<sup>18/</sup> there is no official target beyond the year 2000. Even the very limited band of alternative fertility paths considered here are compatible with a wide range of alternative demographic outcomes. The four projections of table 4 all have as their starting points one of the three projections already discussed, and all have in common the fact that within relatively few decades fertility is brought back to replacement and maintained there, so that the population eventually stabilizes. Projections A and C are simply extensions of the previous A and C projections. In A, after its gentle decline to replacement in 2000, fertility remains constant, and the population stabilizes at about 1665 million. C is the case of rapid fertility decline - after a TFR of 2.0 in 1980-1985, a TFR of 1.5 is maintained until 2040-2045, when it rises again to replacement. This leads to an ultimate size of about 745 million, less than half that in A. Projections B<sub>1</sub> and B<sub>2</sub> both follow the course of B (table 2) until in B<sub>2</sub> this change occurs 20 years later. In consequence the two projections diverge until B<sub>1</sub> exceeds B<sub>2</sub> by roughly 210 million people.

#### Issues of population size

As noted, there is invariably something arbitrary about any attempt to calculate an optimal population. The calculation by Chinese scientists of an optimum population of 650-700 million cannot escape this difficulty, even though it represents a fairly sophisticated attempt to show that separate estimates based on different considerations all converge at a similar estimate. The separate estimates were based on (a) ecological factors, especially the capacity of water resources to support sustained development; (b) the potential for agricultural development, taking into account rising incomes and changing dietary composition; and (c) compatibility with desirable rates of economic development, taking into account likely rates of capital accumulation and technological progress and the changes in production structure and labour allocation which must result from the changing patterns of expenditure as living standards rise.



Table 3. Two alternative projections to the year 2000

Year	A				C			
	Population (millions)	Birth rate --(5-year average)--	Death rate TFRa/ ---	TFRa/ ---	Population (millions)	Birth rate ---(5-year average)---	Death rate TFRa/ ---	TFRa/ ---
1980	979.6				979.6			
		19.5	5.8	2.4		16.4	5.7	2.0
1985	1048.9				1033.4			
		20.3	6.1	2.3		14.7	5.9	1.5
1990	1125.9				1079.3			
		20.4	6.3	2.3		15.3	6.4	1.5
1995	1207.6				1128.6			
		18.5	6.5	2.2		13.4	6.7	1.5
2000	1281.9				1166.7			

a/ TFR: Total fertility rate



Table 4. Four projections of total population, 1980-2100  
(millions)

Year	A	B <sub>1</sub>	B <sub>2</sub>	C
1980	979.6	979.6	979.6	979.6
1990	1125.9	1093.6	1093.6	1079.3
2000	1281.9	1195.6	1195.6	1166.8
2010	1396.4	1303.8	1263.1	1198.4
2020	1497.4	1368.3	1293.3	1202.3
2030	1578.4	1414.6	1326.2	1167.3
2040	1615.8	1429.5	1309.5	1081.7
2050	1631.5	1414.1	1267.5	1000.5
2060	1648.7	1407.8	1238.7	913.4
2070	1660.5	1415.1	1220.2	847.2
2080	1661.5	1419.5	1207.6	799.5
2090	1665.1	1417.4	1205.3	767.2
2100	1666.5	1419.5	1208.0	749.8



Although Malthus himself remains anathema to Marxist economists, the problem of feeding a population of this size is bound to be of major concern to the Chinese authorities. The 1959-1961 famine will not yet have been forgotten. China has been a net importer of grain ever since the famine years and the amounts have steadily increased since the mid-1970s. They now exceed more than 12 million tons a year (though this is still less than 4 per cent of total consumption). Given the size of China's population and considerable uncertainties about the adequacy of grain supplies in other parts of the world, China must aim at remaining essentially self-sufficient in its food supplies. Moreover with more than 70 per cent of its labour force still dependent on agriculture, successful development must involve raising agricultural productivity. Population growth makes this task considerably harder: China already has one of the world's highest ratios of people to arable land and, under pressures from competing uses, the estimated total arable land has been shrinking - from about 111 million hectares in 1957 to about 99 million in 1980. This means that there are currently a little over 1,000 people per square kilometre of arable land - a figure very similar to that of Bangladesh in 1980, but below that of Egypt (1,400) or the Republic of Korea (1,730). It is also well below that of the Netherlands (1,640 in 1980) or Japan (2,360). The alternative projections imply a ratio of population to agricultural land in the year 2000 of between 1,175 and 1,290. Assuming no further shrinkage of arable land, the ratio in the year 2100 would be 800 with projection C and 1,670 with projection A.

It is very difficult to interpret these numbers without a great deal of regional analysis and consideration of the further possibilities for multiple cropping. This is beyond the scope of this paper. China is already intensively farmed - the cropped area in 1979 was about 1.3 times the estimated arable area. Nevertheless, even considering the highest of these figures, and taking into account the need for self-sufficiency and to raise living standards, density and productivity levels elsewhere in the world suggest that size alone should not be a dominant reason for preferring one projection to another.

#### Rate of population growth

A rather different question is whether China can raise its yields fast enough to satisfy its economic ambitions, and how this is affected by alternative growth paths of population. The area under grain remained roughly constant from about 1965 to 1979, when it accounted for about 80 per cent of the total sown area; since then it has fallen slightly. Food yields have risen fairly steadily from 1.6 tons per hectare in 1965 to nearly 2.9 tons in 1981.<sup>19/</sup> A World Bank mission which visited China in 1980 felt that it was plausible to hope for a rise to 3.5 tons by 1990 - a growth of 2.2 per cent a year. This allows for some margin over population growth under all three projections. But under all three, the food situation is likely to remain tight - there will be continued competition for land from non-grain products which have tended to grow faster than grain in recent years, and rising incomes will cause consumers to increase their demand for meat products and hence indirectly for grain.



Beyond 1990, it seems reasonable to expect further rises in grain output per hectare. Several countries have yields that are already higher than those of China, and further technological progress can be expected.<sup>20/</sup> Over time, these higher yields will be obtained with a smaller labour force, as a shift takes place into non-farm activities. The relative poverty of agricultural resources, and the high level of utilization of arable land means that the problem of providing a good livelihood for a dense rural population and maintaining self-sufficiency in the face of potentially diminishing returns to agricultural expansion will continue to demand attention. There are doubtless also several ecological problems associated with the need for more intensive farming, as well as with the expanded urban population.

Nevertheless even the most rapid decennial population growth in the next century of any of the projections is only 8.8 per cent, so that the problem ought to remain manageable. There therefore seems to be little reason to assume that China could not adapt to the increasing pressure on resources that the further growth will involve.

### Changing age composition

Reduction in numbers of children. The effects of alternative patterns of fertility change on the age structure of the population at different points of time are likely to be of much greater economic significance than size itself or the rate of growth. Fertility decline initially manifests itself in reduced cohort sizes at young age groups. The first effects are felt within the family itself. Since children are net consumers, the lower fertility projections imply that families will devote fewer resources to child support and there may consequently be somewhat larger private savings. However, in comparing the alternative projections here, this is very unlikely to have any economic significance, because of several offsetting factors. As we have seen, substantial economic incentives are offered to persuade parents to have one rather than two children. Some of these - where, for example, parents get the same allocation of housing with one or two children - eliminate the resource savings. Others are distributional - e.g., treating an only child as 1.5 or 2 for the purpose of land allocation - and do not affect the total volume of resources. But raising the incomes of parents with one child, such as the payment of child allowances equivalent to 8-10 per cent of earnings plus other benefits, will lead to greater per capita consumption inside the families concerned as well as possible savings. Furthermore the higher (implicit) taxes involved for the rest of the community may have a negative impact on effort.

These considerations make it difficult to assess the net consequences for the rate of capital accumulation, but it is reasonable to assume that the differences due to following one of the above demographic paths rather than another is unlikely to be very significant (especially given the extraordinarily high rates of savings in the Chinese economy - about 32 per cent of GNP in 1981).

Among the potential savings to parents of having one rather than two children will be some health and educational expenditures. We do not have



enough information on health-care costs to be able to estimate resource savings resulting from lower fertility. Very young children are relatively intensive users of health care at the lower echelons of the service, but Chinese costs here are very low. The Chinese pattern of health expenditure has a very high proportion (over 60 per cent) of expenditures on drugs compared with most other countries. It seems reasonable to assume that drug expenditure on each child is below the national average per capita figure of about 10 yuan (of which about two thirds is public expenditure). Resource savings from lower fertility here would be relatively small.

Such savings are far more significant in education where needs and opportunities are particularly affected by fertility patterns (table 5).<sup>21/</sup> The difference between projections A and C in the number of children of primary school age (7-11) widen during the 1990s and exceed 30 million by the end of the century. By that time there are very marked differences in the numbers of children of both junior and senior secondary ages as well. Educational costs per child in primary school were of the order of 30 yuan in 1979. About 16 per cent of this cost was paid by households for fees, books and other expenses. Secondary education was of the order of 75 yuan per student. Private expenditure covered only about 4 per cent of secondary education costs and only 2 per cent or less of higher education costs.

It cannot be assumed that, even if educational standards are held constant, savings on educational expenditure will be proportional to differences in population size. In the first place, while there are still reports of high drop-out rates, especially among girls, and many overage students, China appears already to have the potential for near-universal enrolment at a primary level. In 1980, 146 million pupils were enrolled in primary school, substantially larger than the estimated 126 million in the 7-11 age group (which suggests that there were still many overage students in school). Under all the above projections the population in this age group will fall rapidly to 90 million by 1985, reflecting the decline in fertility in the 1970s. Costs per pupil are bound to rise, since it seems inconceivable that there would be a proportionate elimination of classrooms and schools, or dismissal of teachers. Even in developed countries, with much more urbanized communities, better public transport and more of a tradition of dismissing redundant employees, it has proved difficult to consolidate educational facilities in the face of declining educational needs. Although there is undoubtedly much local variation, China has at primary level already fairly modest student-teacher ratios (averaging 27 in 1979) and average class sizes (34 in 1979) and there are an average of about five classes per school, which, with a five-year curriculum, gives little opportunity for consolidation.

At the secondary level things appear somewhat different. Enrolment in 1979 was about 46 million in the three years of junior secondary and 12.9 million in general senior secondary schools (almost all two years).<sup>22/</sup> For unexplained reasons this total represents a fall from 67.8 million two years before; a further decline to 55.1 million was experienced in 1980 and again in 1981, when only 48.6 million were in secondary school. These figures compare with an estimated 76.3 million aged 12-14 (junior secondary) and 43.1 million aged 15-16 in 1980. So falling cohort size does offer an opportunity for improving enrolment ratios, but it also seems clear that capacity has not



Table 5. School-age population under two alternative projections, 1980-2000 a/

	A	C
	----- (millions) -----	
<u>Primary</u> (ages 7-11)		
1980	122.2	122.2
1985	95.5	95.5
1990	85.0	78.8
1995	100.9	74.6
2000	109.2	75.0
<u>Junior secondary</u> (ages 12-14)		
1980	76.3	76.3
1985	69.9	69.9
1990	54.4	54.4
1995	52.7	46.5
2000	61.1	44.0
<u>Higher secondary</u> (ages 15-16)		
1980	43.1	43.1
1985	52.1	52.1
1990	40.9	40.9
1995	32.3	32.3
2000	39.7	30.5

a/ See cautionary footnote 21.



recently been the main constraint on enrolment levels. However, most of the gains in this respect will be made during the 1980s, reflecting falling fertility in the 1970s. It does not appear as though it should be difficult for the Government to achieve its declared target of making junior secondary education universal in cities, towns and relatively developed rural areas. Looking at primary and secondary levels together, the main issue is not going to be the Government's ability to build adequate classrooms, but to provide teachers of adequate quality. High priority has to be attached to upgrading existing teachers at existing secondary levels - it is estimated that 50 per cent of current staff at senior secondary and 70 per cent of staff at junior secondary are inadequately qualified. Demographic trends should certainly make this easier.

About 65 per cent of educational finance for primary and secondary education comes from the Ministry of Education and a further 25 per cent from provincial and county authorities, and brigades, enterprises etc. Any savings that result from slower demographic growth presumably accrues to them. But for the reasons given this is not likely to be large. At least at primary level, and possibly also at secondary level, the amounts are significantly less than child allowances given to single child families. This is particularly true for the local authorities and public institutions below the central level who bear the cost of the population incentives.

Change in population of working age. Potential resource savings in education continue after the year 2000 in the projection in which fertility is held below replacement, but they will not be very large. Much more significant at that time will be the broader economic effects resulting from differences in cohort size entering the labour force. The effects of the marked fertility decline that has already occurred in the 1970s will of course be felt much sooner. All projections show growth in the population of working age (here taken as 17-64) for the next 30 years (Table 6). Eventually, however, the number of those entering the labour force will fall below those retiring from it and one can anticipate complaints of serious labour shortages. This is especially true in the years 2030-2040 when those born into the large cohorts of the mid to late 1960s and early 1970s retire, and all the projections, even A, show declines in the labour force.

Slower growth of the labour force will undoubtedly be welcomed by economic policy-makers. In the last few years the authorities have had considerable difficulties in placing workers in their first urban jobs, and the problem of overstaffing has been publicly discussed.<sup>23/</sup> Concerns have also been expressed about a high degree of surplus labour in rural areas. Although this may appear to contradict the view that fertility has risen under the responsibility system because farming parents want the labour services of their children, the two ideas are quite consistent (though, of course, either or both may be wrong). The absence of anything resembling a freely functioning rural labour market, and strict controls on migration, means that it is perfectly possible for excess labour and labour shortages to coexist in areas only a short distance apart, let alone in different parts of a vast country.



Table 6. Population of working age (17-64) under four alternative projections, 1980-2100

Year	A		B <sub>1</sub>		B <sub>2</sub>		C	
	(Pop.17-64)	(% total)	(Pop.17-64)	(% total)	(Pop.17-64)	(% total)	(Pop.17-64)	(% total)
	Average annual growth rate (%)		Average annual growth rate (%)		Average annual growth rate (%)		Average annual growth rate (%)	



It is not at all unlikely that these problems will still be serious ones after the turn of the century, and the continued easing of the situation implicit even in projection A will probably appear highly desirable. In the period 2000-2010, projection C appears to have favourable conditions for relatively rapid growth in incomes per head. In contrast to projection A, the number of dependants would shrink in absolute numbers as well as in relation to the population of working age, and there is therefore potential for relatively more rapid capital accumulation. The degree to which this potential would be realized depends on savings propensities which are impossible to predict, and the net effect on output of faster capital accumulation, and slower growth in the labour force depends on the prevailing relative returns to both factors which cannot be sensibly estimated. It is likely that the activities most affected will be in agriculture. If China achieves its ambitious economic target of quadrupling its 1980 output by the year 2000, and thereby attains an income per head of between \$ 900 and \$ 1000 in 1980 prices, analogy to present day middle-income countries suggests that it will still be predominantly agricultural, at least as far as employment patterns are concerned. It is not unreasonable to assume that, at the turn of the century, the returns to additional manpower in agriculture may be fairly small, and the difference in net output between projections A and C may also be correspondingly limited. Furthermore even the growth rate of the labour force projected under A is not large by post-war Chinese or international standards and is hardly a decisive reason for choosing among alternative paths.

After the year 2010 the population of working age begins to shrink under Projection C, presumably accompanied or closely followed by a corresponding drop in the labour force. Under the other projections, this drop comes somewhat later and to a lower degree. Negative growth in the labour force does not carry the same economic advantages as slower but still positive growth. There are likely to be adjustment difficulties. New activities cannot be staffed principally from the growth in the urban labour force; they require the absolute shrinkage of old activities and perhaps the scrapping of plant. Furthermore, the average age of the labour force will be rising - there may be difficulties in adapting to new production possibilities requiring substantially different skills, since these are more easily taught to younger workers. These problems will be felt under all of the above projections, even A, but they will be most serious and prolonged under C.

Historically, other situations of labour force decline have either reflected international emigration under conditions of severe economic distress, such as that from nineteenth century Ireland, or are regional phenomena within the context of a growing labour force. It is clear that neither is a useful precedent to China in the next century. In principle one could argue that a large well-organized appropriately planned economy could readily cope with a shrinking labour force, even over several decades, and even at rates as high as 1.8 per cent per year which are reached under projection C. It might be argued that such a shrinkage is trivial in relation to the normal depreciation and scrapping of equipment in manufacturing, and that the spur to less labour intensive methods will lead to a rapid rise of productivity. In agriculture, an opportunity for consolidating holdings and mechanization may be welcomed. But such optimism depends on confidence in an adjustment process that reallocates productive resources smoothly and



efficiently among activities. When plants have to be closed to preserve economies of scale in others in a different location, labour will have to be able to move within the rural economy. Prices, if set by market forces, could be the most useful signal of surpluses and shortages which will undoubtedly occur.

Until very recently, the Chinese economy operated on principles that appeared to minimize the chances of such successful adjustment. Labour has been, and remains, extremely immobile both geographically and between work units. Prices still do not signal relative resource scarcities or returns to factors at all well. Recent reforms do, however, indicate an intention to move in this direction. Declining labour force growth, and the prospect of periods of shrinkage even under the highest fertility projection, add even more importance to the needs for such reforms.

Changes in the proportion of the elderly. An even more serious problem, which will also be worse under projection C, will be that of supporting the elderly. Once a stationary population is reached, the proportion of the population of 65 and over will be 20.6 per cent (on the common mortality assumptions used for all these projections). The population of working age (17-64) will be 58.5 per cent, slightly greater than the 56.5 per cent of 1980, so that the proportion of dependants per member of the labour force need not be very different from today. The demographic structure of dependency will be very different, however, since in 1980 only about one out of eight dependants (excluding non-working dependants ages 17-64) was 65 or over; in the stationary population it will be about one out of two. The problems associated with elderly dependency are more complex than those arising from high levels of youth dependency. As noted above, the elderly typically have greater consumption needs than the young, especially for house space. Traditionally, Chinese elderly parents have lived with married sons but modernization and urbanization may make it difficult for them to reside with their children. If the elderly remain in separate economic units, there must be a mechanism for providing them with an income. The 1980 marriage law still refers to the traditional filial duty to support elderly parents, but the Chinese have already realized that parents cannot reasonably be expected to depend solely on one child. They have recognized the danger that some couples might end up with responsibility for four parents and eight grandparents. In at least some provinces, parents have been led to understand that if they agree to have only one child, the community will supply them with an adequate alternative source of economic support.

Although all countries will eventually face the same problem, China is likely to find it more serious than most, both because the country is likely to reach a stationary population sooner and at a much lower level of development than most other developing countries, and because fertility has fallen so fast and to such low levels that there is some danger of incurring even more serious problems of supporting the elderly, some decades before a stationary population is reached. As table 7 shows, the alternative projections show very different paths. In projection A, the proportion of the elderly increases slowly to its ultimate size with very little fluctuation. B<sub>1</sub> is not very different. In contrast, in projection C, and to a lesser



Table 7. Population aged 65 and over as a proportion of total and in relation to working age population (17-64) under four projections, 1980-2100

Year	A		B <sub>1</sub>		B <sub>2</sub>		C		
	(Pop.65+) (%)	(total) (17-64/65+)	(Pop.65+) (%)	(total) (17-64/65+)	(Pop.65+) (%)	(total) (17-64/65+)	(Pop.65+) (%)	(total) (17-64/65+)	
1980	51.2	5.2	10.9	5.2	10.9	5.2	51.2	4.7	10.9
1990	75.9	6.7	9.6	6.9	9.6	6.9	75.9	6.5	9.6
2000	104.3	8.1	7.8	8.7	7.8	8.7	104.3	8.7	7.7
2010	128.3	9.2	7.1	9.8	6.7	10.2	128.3	10.7	6.6
2020	185.8	12.4	5.2	13.6	4.7	14.4	185.8	15.9	4.5
2030	249.8	15.8	3.9	17.7	3.5	18.8	249.8	21.4	3.0
2040	316.7	19.6	3.0	22.2	2.6	24.2	316.7	29.3	2.0
2050	304.5	18.7	3.2	21.3	2.7	23.8	291.0	29.1	1.9
2060	327.1	19.8	3.0	19.6	3.0	22.3	263.3	28.8	1.8
2070	341.8	20.6	2.8	20.5	2.9	22.2	239.6	28.3	1.9
2080	334.0	20.1	2.9	20.8	2.8	20.6	202.9	25.4	2.2
2090	341.8	20.5	2.8	20.2	2.9	20.3	182.8	23.8	2.3
2100	343.8	20.6	2.8	20.6	2.8	21.0	165.0	21.0	2.8



extent, in B<sub>2</sub>, the elderly become an extremely large proportion (about 29 per cent) of the population for several decades after the year 2040.

Supporting such a large ratio of pensioners to producers could prove very difficult. If not anticipated, the need to finance such a level of support could be a severe drain on potential resources for investment, and the taxation needed might be a deterrent to productive effort. The generation that will create the most severe burden is, of course, the large cohorts of the later 1960s and early 1970s. These are now beginning to enter the labour force. It is not too soon for the Chinese to promote the establishment of proper pension funds to cover the retirement of these workers, with opportunities to earn interest and reinvest the very substantial net income that such funds would receive in their early years. Even though any pension constitutes a claim on resources in the year in which it is paid, however it is financed, there is both a political and an economic advantage in not having to pay it from tax revenues. If a pension is clearly the return on a capital investment earlier in life, then it need not be seen as a burden on the present generation of workers, but as the reward of saving by the previous generation which has made possible the present (presumably higher) level of productivity.

In the absence of a well-functioning capital market, it is not easy to envisage how such pension funds might originate. But it is an important and urgent issue if present population policies continue. Such pension schemes should not be seen as ways of supporting today's (non-contributing) elderly but as ways of marshalling investment funds. Properly organized, they would become a very powerful economic force, and might be used to channel funds from one part of the Chinese economy to another.

A particular problem will be to develop mechanisms of old-age support that are compatible with the need for increased flexibility, described above. It would be a mistake, for example, to make pensions dependent on continuing to work for a particular enterprise or reside in a particular community, if other reforms are simultaneously trying to impart smoother adjustment mechanisms to facilitate the movement of labour from one activity to another.

Questions of how best to replace children by community or national government as a source of support in old age are almost certainly going to be the most difficult of the issues raised in this paper. This question is one which is looming increasingly large in developed countries. Nowhere yet, however, has the proportion of the elderly reached those that will be encountered in China in a few decades, but already, at much higher levels of income, there are serious problems. This paper cannot begin to explore the many issues that are raised, but it is clear that there are few, if any, models that could usefully guide the Chinese. China must be prepared to think seriously about some of the norms which have been adopted more or less automatically in the developed world with respect to the age of retirement, or the right of the elderly to life-prolonging medical care, and perhaps to innovate here as dramatically as the country has already done in the area of fertility reduction.



### Distributional issues

In the early years - to approximately the end of this century - only the size of the population under working age is affected by different fertility levels. The main consequences will be felt within the families concerned, and to a lesser degree, the communities in which the families live. The division of the costs and benefits between the two will depend crucially on the pattern of economic incentives and disincentives offered to individual parents and on the public services provided, and on the principles of allocating resources and distributing income. Households that have lower fertility will enjoy improved consumption levels. There may be some additional private saving, but, as noted, it is unlikely to affect the rate of capital accumulation and hence society as a whole very much. Resource savings, if any, in the rest of the community would be relatively small, since there is already in place a good network of public services for children, and because lower fertility is assumed to imply the continuance of the present system of incentives.

It is reasonable to assume that under present policies, the main variable determining the path to be taken by fertility is the strength of population policy in rural areas. It is not quite clear, however, what would be the relative effect of different fertility levels on the rural-urban distribution of income. Lower fertility would raise potentially rural disposable income. But it would also lead to a relative shift in consumption patterns away from basic foods, which might ease diminishing returns in agriculture, and make it easier to raise output per head, towards the manufactured products of urban areas. In any case, compared with the strength of similar consequences from rising incomes in general, those resulting from alternative fertility patterns would be small.

After the year 2000, the disparity in potential economic effects between alternative projections becomes much greater, as marked differences occur in rates and, soon, directions of change in the population of working age. While the effect on aggregate output is ambiguous, in the earlier decades of the twenty first century, growth in incomes per head will be faster in the low fertility case. The lower fertility projections will be associated with the relative easing of the pressures on agricultural land, and a labour force growth of a rate modest enough to pose no special difficulties in providing new workers with productive employment, but rapid enough to permit adjustments in labour allocations among sectors. These gains from slower population growth should be widely diffused, both among the families with lower fertility and the rest of Chinese society.

After 10 or 20 years of the next century, however, the benefits obtained from lower fertility in the closing years of this century and the early years of the next look much more dubious. By then economic progress may be impeded by difficulties in adjustments required by a shrinking, aging labour force, and by problems in supporting the elderly. It is not easy to pick particular losers and winners in this process in sectoral or geographic terms. Unless fully funded pension schemes are developed, however, there will be a major distributional conflict between age groups as the shrinking post-1970 cohorts born after the early 1970s struggle to support those born during the preceding two decades.



### Conclusion

Relatively small differences in fertility levels, and in the timing of the achievement of replacement level fertility, can lead to striking differences in ultimate population size. It is argued, however, that the main issues determining the relative economic benefit of alternative demographic paths are more likely to be rates of growth and issues of age composition rather than size itself. If true for such a large and densely populated country as China, it is likely to be a fortiori the case for most other countries, which are relatively richer in natural resources and more easily able to relieve shortages of particular resources through international trade.

Like many other discussions of economic-demographic relationships, there is an inevitably tentative air about the economic consequences of these alternative projections. The problem is that the differences among rates of change of total population or age groups normally amount to only one or two percentage points, which are small in relation to the recent historical experience of economic growth in the most successful countries, which China hopes to emulate. In general, lower fertility imposes fewer demands on resources but requires greater flexibility to adapt to changing conditions. Confidence in the likelihood of technical progress and widespread productivity gains would favour the relatively higher fertility path. Confidence in the country's ability to adopt new, more flexible social and economic mechanisms to adjust to changes in rates and direction of labour force growth and the inevitably greater burden of supporting the elderly would favor the relatively lower fertility path. It seems reasonable to assume that both are possible but neither is assured. Perhaps international experience elsewhere is more encouraging with respect to technological than institutional change, but the past history of very tight food supplies, and the impossibility (because of the huge numbers involved) of relying more than marginally on outside supplies, makes China understandably cautious in this respect. There is no obvious way of predicting which would be the safest and easiest course to take.

China's fall in fertility has been very fast and has taken place at a particularly early stage of development. Whatever path China takes, these projections demonstrate how fertility decline can, within a very few decades, bring a developing country from a state of high fertility to facing many of the economic-demographic problems that still remain a formidable challenge to developed countries. Other countries will soon face similar issues, even if less starkly. The problems of transition to a stationary population deserve more attention than they have received.

### Notes

1/ The specification of a total fertility rate for every year does not uniquely determine either the rate of growth of population nor the ultimate stationary population size (following decades of replacement-level fertility). These variables also depend on the age pattern of fertility and also on mortality, which will determine what proportion of women survive their



full reproductive years. Possible variations on these accounts are ignored in this paper.

2/ Joseph van den Boomen "Age-cost profiles: A common denominator" in International Union for the Scientific Study of Population, International Population Conference, Manila 1981, Selected Papers, vol. 3, pp. 286-293.

3/ Educational costs, however, differ greatly in proportion to per capita income. See M. Zymelman, "Patterns of educational expenditures", World Bank Staff Working Paper No. 246, November 1970.

4/ For a discussion, see Angus Deaton "Inequality and needs: Some experimental results for Sri Lanka" in Income Distribution and the Family, supplement to Population and Development Review, vol. 8, 1982, pp. 35-49.

5/ Kenneth Hill, Supplementary Technical Paper to Health Sector Issues in China, Report of the Rural Health and Medical Education Mission (September/October 1982), (World Bank, 1983).

6/ In general these birth and death rates are substantially higher than the official estimates before 1958. This is not surprising, since there was a fully national system of vital registration only after 1956, and soon after this came the statistical chaos of the Great Leap Forward. Another statistical collapse accompanied the Cultural Revolution, so that a further discrepancy between the rates estimated for the second half of the 1960s and those officially reported is also plausible. In the early 1970s the underreporting of births to achieve family planning norms has been officially acknowledged (Sun Yefang, "Consolidate statistics work, reform the statistics system", Economic Management (Jingju Guanli) (15 February 1981) pp. 3-5, in FBIS (26 March 1981, L4-9).

7/ A valuable description can be found in Pi-chao Chen and Adrienne Kohls, "Population and birth planning in the People's Republic of China", Population Reports, Series J, March 25 (January-February 1982).

8/ This is equivalent to about 8 per cent of a typical urban wage. One yuan is approximately 50 US cents.

9/ People's Daily (5 February 1982).

10/ Directives on Population Control issued by the Communist Party Central Committee and the State Council, 13 March 1982.

11/ Chen and Kohls, op. cit., p. J 600.

12/ Beijing Center for Communication and Education for Family Planning, Topics in Population Theory (Renukou Li Lun Xuan Jiang), pp. 184-185.

13/ In the first half of 1981 there were 6.37 million marriages compared with 3.26 million for the first half of 1980 and 7.45 million for the whole of 1980. This does not reflect an increase in the numbers of people reaching marriageable age - the late 1950s and early 1960s were a period of falling



birth rates, and the cohorts born in the peak birth years of 1962-1968 will not affect the numbers marrying until 1982 at the earliest.

14/ For example, in his 1981 report on the economic situation, given to the Fourth Session of the Fifth National People's Congress, Premier Zhao Ziyang also attributed local reports of a rising birth rate to the responsibility system; see Zhao Ziyang, China's Economy and Development Principles (Beijing, Foreign Languages Press, 1982), p. 62.

15/ Analysis in other countries suggests that if there are alternative possibilities for saving, even with fairly low interest rates, children would be a poor investment on this score (though parents may not know this). Mead Cain, "Risk and insurance: Perspectives on fertility and inequality in rural India and Bangladesh", Population Council, Center for Policy Studies Working Papers, No. 67 (April 1981), p. 51. Robert G. Repetto, "Direct economic costs and value of children" in Ronald G. Ridker, Population and Development: The Search for Selective Interventions (Baltimore, Maryland, Johns Hopkins Press, 1976), pp. 77-97.

16/ On the assumption that the Chinese are not referring to an average that includes past family sizes. Until the 1970s these were very large, since total fertility rates exceeded 6.0.

17/ All of the projections are based on the Coale-Demeny South Model Life Tables until 2005, and West Model Tables thereafter. Mortality slowly improves, until a life expectancy of 81 is achieved in 2055-2060. This projection is very similar to the World Bank projection to be published with the World Development Report 1983, but the latter is based on somewhat slower, smoother changes in fertility, reaching a total fertility rate (TFR) of 1.5 in 1990-1995 and then rising to replacement in 2000-2005.

18/ Song Jiang, "Population development - goals and plans" in Liu Zheng, China's Population: Problems and Prospects (Beijing, New World Press, 1981), pp. 20-31.

19/ Some experts believe that the area under cultivation of some crops, particularly wheat, is under-reported and that yields are consequently lower.

20/ A yield of 3.5 tons in 1990 would be comparable to average current yields in Europe, and well below the 5 tons obtained in Japan and sometimes in the Republic of Korea.

21/ The projections of table 5 have to be treated with even more caution than the other projections of this paper. All of our projections are designed solely to illustrate the consequences of a small number of alternative fertility patterns. Fertility is assumed to change abruptly between periods, stay constant for a time, and then to change abruptly again. Analysts concerned with making the most plausible prediction of the passage of total population or its components over time would probably prefer to make these changes more smoothly. The assumptions about the pattern of age-specific fertility also differentiates very sharply between different five-year cohorts, and smoothing here would also have been possible. Moreover, as we



have seen, the age structure for 1980 is not known with certainty and itself reflects some sharp fluctuations in past cohort sizes. Small changes in assumptions could easily therefore change dramatically the number of births projected for any one year. The projection techniques used elsewhere in the paper are concerned only with estimates of five-year age groups at five-year intervals, so that year-to-year fluctuations in the number of births can be ignored. However, projections of the population in school-age categories means that the five-year age groups have to be disaggregated and assigned to individual years, which has been done by the computer following a standard set of interpolation procedures. These are not designed to cope with situations of abruptly changing fertility patterns and introduce another arbitrary element into the projections.

22/ These exclude non-formal and vocational secondary education, and training schools for skilled workers.

23/ For example, Xue Muqiao, "Economist talks on major problems in reform efforts", China Daily (11 March 1983). See also Liu Xianghai, "Tentative ideas on reform of the labour employment system", Population Study (Renkou Yanjiu), No. 5 (1982), pp. 8-12.







## C. Integration of population factors into development planning and programmes

United Nations\*

### Introduction

The World Population Plan of Action explicitly affirmed the important role of population in development and the need for the integration of demographic factors in development planning, and recommended that "population measures and programmes should be integrated into comprehensive social and economic plans and programmes and this integration should be reflected in the goals, instrumentalities and organizations for planning within the countries".<sup>1/</sup> The Plan of Action recognized that the ultimate aim of development was not only to accelerate economic growth but also to reduce disparities in income, education, health and other social services among diverse social classes.

Also emphasized was the need to formulate adequate population policies and to implement them as an integral part of national development strategy, taking into account the interactions between social and economic variables and population factors.

In carrying out these recommendations, the United Nations has expanded its technical co-operation activities with the countries concerned in diverse population and development fields, including studies of the interaction between social, economic and demographic variables, the formulation and implementation of policies, the integration of demographic factors in the planning process, the training of national staff, and the improvement of the data base and institutional arrangements.

### Country problems and policies

Most countries have been aware of the close association between population and social and economic development, and that the population is not only the beneficiary of development programmes, but also an essential component of the development process in its role as the source of human resources. Although the interaction between structural change in population, on the one hand, and social and economic development, on the other, is generally recognized, at the aggregate, sectoral and regional levels, it has not thus far been possible to take this factor fully into account in the development planning process in many countries.

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\* Department of Technical Co-operation for Development, United Nations, and the Population Division of the Secretariat of the Economic and Social Commission for Asia and the Pacific.



In many developing countries, structural change in population trends has not encouraged economic development and in many cases has created serious obstacles to the achievement of national development objectives. The rapid population growth, especially in the least developed countries has been directly associated with a host of problems including unemployment, appalling housing conditions and health hazards. Even in countries in which the rate of economic growth has significantly increased, per capita income gains have been relatively modest because of a high population growth rate. In part as a result of demographic trends, economic growth has often increased the share of total income going to the already privileged sector of the population.

In recognition of this problem more and more countries are giving high priority to social objectives in their national development plans. Instead of restricting the objectives of development to economic growth and raising per capita income, an increasing number of Governments have been focusing their efforts on eradicating poverty, reducing social injustices and improving the living conditions of each individual and the population as a whole.

Internal migration, often in response to imbalances between the spatial distributions of population and resources, has also created serious problems for regional development. Rural poverty and underemployment combined with urban crowding and unemployment have been closely associated with both rapid population growth and development, and with unbalanced spatial distribution and undesirable rural-urban migration trends. In many developing countries, urban development and industrialization have led to high concentrations of economic activities in and around well-established areas, encouraging rural-urban migration, causing pollution and unemployment in already overcrowded areas. While migration may bring to the receiving areas the labour force needed for their development, it may also contribute to an increase in income disparities between rural and urban areas.

It is generally recognized that changes in the size and structure of population influence the development of certain planning sectors, for example, in calculating requirements in health services, education, food, housing and social welfare. Although progress has been made in planning, especially in health, education and manpower planning, demographic factors in most cases have not been incorporated as an integral part of overall development planning in a broad multidisciplinary context.

Conversely, efforts to study the effects of sectoral development on population change have fallen far short of policy requirements. Needed are studies of the impact of development in health, education and food supply on mortality reduction, and of urban housing and social welfare programmes on rural-urban migration trends.

Many Governments, finding that trends in population have not been in harmony with development policies and goals, have felt it necessary to formulate population policies to modify demographic trends. However, in too many cases, population policies have been formulated and implemented in isolation, and not in harmony with development policies or as an integral part of overall development strategy.



Deficiencies in achieving integrated population policies and integration of demographic factors in the development planning process have often been caused or aggravated by a deficient knowledge of the interactions between demographic and socio-economic factors and by insufficient expertise, resources and proper institutional arrangements in the field. Although an awareness of demographic problems has been increasing in most countries, the formulation and implementation of country projects and programmes to solve these problems have often lagged badly. As a result, Governments have requested assistance in the field of population and development in the years since the 1974 World Population Conference.

Research studies on the interrelationship between demographic variables and social and economic factors have been among the most frequent population activities undertaken during the last decade, since they provide the basic input for population policy formulation and the integration of demographic factors in development planning.

A general overview and examination of the nature of the relationships among demographic, social and economic factors, including the assessment of country knowledge in this field has usually been the first basic activity of population and development projects. In general, these studies have been carried out on the basis of available data and information, mostly from past population censuses, socio-economic surveys and registration systems of various government offices. Such studies may contribute to the assessment of country problems and needs in the field of population and development and to the identification of specific activities which need to be undertaken.

Lack of knowledge concerning migration patterns has been a particular source of concern to many Governments since migration is closely related to many vital development processes and objectives. Emphasis has been placed on analysing internal migration patterns and their causal interrelationships with development factors. Important areas of study are: the actual and potential level of development of resources, generating employment and the development of education and health services, both in areas of departure and of destination. Other socio-economic factors directly linked to the individual, household or community, such as household income, profession, marital status, religion, traditions and beliefs, are also included in these studies. The importance that Governments attach to each factor depends on the knowledge of migration patterns, the availability of data and resources and also on the main objectives of these studies.

Most migration studies have been carried out on the basis of data provided by population censuses or national migration surveys, or from ad hoc surveys in selected areas, using a limited number of specific variables. These surveys have been designed for in-depth studies, especially at the community and village levels.

The interrelationship between migration and rural and urban development has also been of concern to most developing countries. Mass migration from rural areas to cities not only creates pollution, overcrowding and unemployment in the cities, but also deprives rural areas of a young and active labour force for potential development.



The movement of nomadic populations is also of concern to a number of Governments, particularly in countries where the proportion of nomads is large. In fact, this constant movement makes it difficult to estimate and prepare sub-national projections on basic requirements for food, education and health services.

International migration, though given a relatively low priority by most developing countries during previous decades has begun to cause concern to an increasing number of Governments. International immigrants have exerted a great impact not only on demographic structure, but also on the social and economic situations of host countries. Many Governments are conscious of the need to achieve a better understanding of the impact of immigration and to take it into account in the development planning process. However, no extensive studies on this subject were carried out during the previous decade. The scarcity of information on international migration, especially in relation to social and economic development both in the countries of departure and of arrival, is due to the lack of reliable data and also the difficulties involved in obtaining full participation and co-ordination between the countries concerned.

Many countries have come to realize that there is a significant association between the level of fertility and mortality, on the one hand, and socio-economic conditions, on the other. Studies have generally been undertaken as research components in the context of maternal and child health and family planning programmes or in the context of population policy and development planning. In general, these studies have shown that improvements in living conditions, educational levels and income have been significantly correlated with reductions in fertility and mortality levels.

Studies of mortality patterns and their relationship with socio-economic factors were also neglected by many countries in the previous decade, perhaps because mortality levels had been declining in many parts of the world. However, in some African countries, a high level of mortality, particularly infant mortality, remains a source of concern. Some studies on the relationship between infant mortality patterns and socio-economic factors - for example, education, nutrition, economic activities, employment status, household income etc. - have been carried out by the countries of the Sahel region.

In some countries, studies on the interrelationship between population factors and development have been confined to a consideration of the impact of population size and age/sex distribution on consumption patterns, and country resources development. This type of study usually leads to the projection of consumption needs of the population which have been, in many developing countries, basic elements used in formulating policies on population growth.

Studies on the spatial distribution of population and resources development at the national as well as the regional level were carried out during the last decade by many Asian countries and led to the adoption of policies calling for the reduction of population growth through family planning programmes.



In most population and development projects, the interrelationship among the conditions of women, fertility behaviour and women's participation in the work force has been analysed but few individual projects have been designed especially to study women's problems and their role in development.

For many Governments, population policies are no longer limited to the reduction of population growth, but are conceived of in relation to social and economic development and studies of the interaction between population change, and social and economic factors have served as basic elements for the formulation of population policies. Determining the potential impact of alternative population policies on social and economic development objectives has also often been part of efforts to formulate improved policies in the context of the strategy of development.

The population policies most frequently formulated and implemented during the last decade dealt with fertility, population growth, migration (internal and international) and mortality. Policies on the reduction of fertility and population growth have been adopted in most of the countries of Asia and in most cases have been well implemented. Countries in Latin America, Africa, Western Asia and Asia and the Pacific have also been interested in migration policies. Though most countries, however, are still at the stage of studies and formulation of policy, some countries have actually implemented migration policies, such as population resettlement and the reduction of rural-urban migration, through social and economic decentralization and the creation of new development zones in rural areas.

Many countries have recognized the need to strengthen existing institutional arrangements for population policy formulation and to better integrate demographic factors into the development planning process. Several national population commissions have been established, most of them at the cabinet level. Their main functions are to define adequate population policies in the context of social and economic development to co-ordinate the implementation of these policies as well as that of other population-related activities.

Population units, which usually constitute the technical secretariat of the national population commission, have also been established. In certain countries, especially where there was no national population commission, population units are often located in the ministry of planning or the ministry of social development. More than 15 population units or centres or similar institutions which deal with research for population policy formulation and the integration of population factors into national development planning have been established with the technical co-operation of the United Nations.

Activities to integrate demographic factors into development planning depend a great deal on studies of the interaction between population change and social and economic factors and also on the results of specific research projects for population policy. In general, there have been very few country projects designed specifically for the integration of demographic factors in planning as such. The subject of integration of demographic factors usually has been part of a larger population and development study project or part of the national population unit's activities.



Because of the large number of variables and assumptions involved, large-scale demo-economic models have generally been considered impractical as a diagnostic and predictive instrument. However, the incorporation of demographic factors into small-scale development models has been successful in many developing countries. Some sub-models have been used to explain the interrelationship between certain demographic variables and development factors, and the impact of population policies on development planning objectives. In Bolivia, for example, efforts are being made to integrate such demographic variables as population growth, size and sex/age structure of family, and urban and rural distribution in household consumption models. The use of other sub-models has also been explored to examine the impact of population policies on development programming.

Although the paucity of reliable data concerning population and development has been one of the obstacles to research in this field, only a few projects have been designed specifically to collect demographic, social and economic data apart from particular studies. In other words, improvement in the quality of data has been linked more and more with the objectives of specific studies. For example, ad hoc surveys designed to collect needed data for specific studies have been numerous in the field of population and development.

Improvement in the quality of data and information has also been sought through the establishment of data bases including the standardization of definitions and concepts, the correction of errors and the adjustment of differences due to coverage and time reference.

Although the role of population in development has been fully recognized and some countries have significantly improved their knowledge of the interaction between population change and development, many others are still at the exploratory stage. In these countries, research and studies in the field of population and development have either been lacking or have not aimed at grasping the complex interaction between demographic and development factors with a view to formulating population policies and integrating population factors into development planning. In many countries, especially in Africa and Western Asia, population activities are still limited to the collection and analysis of demographic data. The lack of interest of planners in demographic studies, the lack of local expertise and experience in the field of population and development and the limitations of resources are some of the problems that need to be solved.

In spite of the increasing awareness of the role of population in development, the importance of formulating population policies has not been well understood by certain planners and policy-makers. Often, population policy research and formulation has been left to the discretion of demographers and statisticians. The lack of co-ordination among the government offices involved has also been an obstacle to population policy formulation.

Among countries that have taken action to control or modify demographic trends, especially internal migration, some have failed to achieve their objectives for lack of attention to the demographic impact of socio-economic



factors, such as religion, tradition, culture and ethnicity. Specifically, programmes for the decentralization of development which aim at reducing disparities in income, education and employment among social groups often create new problems -- overcrowding and unemployment -- because the population policy relating to migration has not been well defined or formulated on the basis of studies of the impact of development on migration behaviour.

Where family planning programmes have been implemented as a means to curb population growth, the social and economic aspects of these programmes and their impact on development have often been neglected. Research on the impact of family planning programmes on the social, cultural and economic conditions of the population and on the potential for development of resources in terms of labour force supply, employment and consumption requirements would provide a valuable input to development planning and facilitate the integration of family planning programmes into the overall national development plan.

Progress has been rather slow in the integration of demographic factors and population policies in the development planning process. In many countries, demographic studies have not been designed for development planning purposes, simply because the demographers who have carried out these studies were not familiar with the development planning process and techniques. Also, some planners have taken the view that the role of population in development planning should be confined to a consideration of the impact of population size and growth. In some countries, the development strategy has overemphasized economic growth and neglected to take into account the problems and needs of the various segments of the population.

Adequate institutional arrangements for the formulation of population policies and the integration of population factors in the development process are still lacking in a number of developing countries, although the importance of these arrangements has been generally recognized and some progress has been made in this field.

The respective roles of government institutions for population research and study and the formulation of population policies often have not been well defined. In a number of developing countries differences still persist among the offices of statistics, planning, labour, health and social welfare, concerning responsibility for supervising population research activities, since there is no central institution in the Government to co-ordinate these activities.

Many Governments still assign relatively low priority to the formulation of population policy and the establishment of related institutional arrangements. In addition, the fact that population is still understood as family planning by a number of Governments delays the legislative procedure necessary to establish such institutions.

Although a very large number of national staff have been trained during the last decade, a lack of expertise and experience, especially in population policy and development planning, persists in many countries. Since training is a long process, the assistance of international experts and consultants will be necessary, at least for a certain time, not only for research



concerning the formulation of population policy and the integration of demographic factors in development planning, but also for continuing the training of local personnel, so that projects may continue satisfactorily after the departure of the international staff.

#### National institutional capacity in population and development planning

In a growing number of countries, particularly in Asia and Latin America, steps are being taken to establish institutional arrangements for the consideration of population elements in the formulation of social and economic policies and development plans. In other countries the consideration of population variables in national planning is still very incomplete; they continue to be treated as exogenous planning components. Also, population policies and targets continue to be adopted largely independently of the social and economic policies and of the major socio-economic aspects of the development plans.

The elaboration of an integrated approach to population, human resources and development planning requires a continuous long-term effort and much hard work in such areas as data collection, processing and analysis and policy research. For this purpose, there is a need to create a viable national institutional capacity through the establishment of a population planning unit staffed with qualified persons from relevant disciplines, at high levels within the administrative structure of national planning bodies. The substantive content of the work programme of these units would of course vary from country to country.

#### Strengthening national institutional capacities

The problems of population and human resources as related to various population and development interactions are extremely complex, with major implications for national population and development policy goals. Though many of the consequences of population dynamics on development are long term in nature and not highly visible, empirical studies point clearly to the need for relevant policy research work on population-related issues as an element of the national socio-economic planning and policy-making effort.

The developing countries' requirements for dealing with population and related development problems obviously vary from country to country depending on their unique demographic, social, economic and political conditions. It is now well recognized that adoption of a single-purpose population programme dealing with only one specific population issue will not be effective. There is a need for a broader approach to the adoption of population policies and development planning strategies. For comprehensive development planning, population problems must be considered in their broad perspective. They relate not only to population growth but also to the prevailing levels of mortality and population movements, particularly rapid rural-urban and international migration.



### Integration of population and development in the ESCAP region

The study of population has from a very early stage recognized the two-way interrelationships between population and development variables. Various aspects of population affect the development process and its various manifestations, and are simultaneously affected by it. Since population and development are interconnected, there has been a growing recognition that the two could be dealt with in a more unified fashion. This position was reaffirmed in the World Population Plan of Action adopted by the World Population Conference in Bucharest in 1974. "An integrated approach to population and related development issues" was also accepted as the theme of the Third Asian and Pacific Population Conference, held at Colombo, Sri Lanka, in September 1982. "The Conference aimed to further understanding of the two-way interrelationships between population and development and to stress the need to take into full consideration relevant population factors in the formulation and implementation of policies and programmes for achieving overall national development goals, and recognize, in particular, the influence of development on population dynamics".

Though the idea of integrating population and development issues is attractive, it raises problems both at the formulation and implementation stages. The very concept of integration has been defined in various ways in different contexts to denote co-ordination or collaboration or a complete merger of demographic and developmental approaches. However, it is generally recognized that integration connotes the establishment of linkages between interdependent and interactive sectors of population and development programmes.

While the two-way relationship between population and development issues is recognized, the elements or aspects of both population and development that are considered suitable and amenable for integration would depend upon the circumstances prevailing in each country. The population aspects include size, density, growth rate, fertility, mortality, age structure, spatial distribution, internal migration, urbanization and the growth of cities and international migration. In the ESCAP region the majority of the countries are concerned about their rapid rates of population growth, and more specifically, programmes related to family planning continue to be of vital importance. However, almost every population variable has a vital link with the development process, and has assumed importance in one country or another in certain stages of their development. Development issues that have received special attention in this context are maternal and child health care, the reduction of infant and child mortality, the provision of nutrition to children, education, rural development programmes, population redistribution, the increased participation of women in development, and community participation in development programmes.

There can be no uniform prescription for the integration of population and development issues. It depends upon the population and development situations facing individual countries and must be carried out within the existing socio-economic and cultural framework. In the ESCAP region, the majority of the countries have been concerned with population growth and high fertility;



but in more recent years, and for some countries, fertility has fallen very significantly and concerns with regard to spatial distribution and international migration have assumed greater priority.<sup>2/</sup>

Vigorous attempts have been made to co-ordinate family planning programmes with maternal and child health care, nutrition programmes, social welfare and rural development schemes. There is increasingly clear evidence that though family planning programmes have had an independent effect in lowering fertility rates in many countries, their impact tends to be greater in situations where socio-economic development trends are also conducive to fertility decline. In all of the recent sharp declines in fertility among rural populations of Asia, family planning and other government programmes would appear to have played a major role.<sup>3/</sup> The integration of population and development programmes in this situation is therefore apt to provide greater potential for the success of the programme in reducing fertility.

Apart from this favourable trend, the search in recent years for specific developmental policies that can be expected to influence population growth rates has yet to produce a very actionable list of policies.<sup>4/</sup> In his review of the situation in Asia, Gavin W. Jones concluded that "there is a long way to go before population is fully integrated into development planning in the region, if 'full integration' is taken to mean that effects of economic policies and trends on population trends (and vice versa) are given close consideration".<sup>5/</sup>

The available evidence does suggest that progress has been made since the Second Asian Population Conference in integrating population planning into development planning. The planning structures developed to bring about this integration have varied among countries in the ESCAP region. For instance, Bangladesh, Pakistan and Sri Lanka have established a population division at the central ministerial level. A population commission, a leading group or a department in a central ministry have been established in countries such as Burma, China, India, the Philippines, Maldives and Nepal. High level national family planning/population boards have been created in Indonesia, Malaysia and Singapore. Committees on population policy have been directing and overseeing the population programmes in the Republic of Korea and Thailand. In some other countries, the responsibility for population policy has been attached to central planning offices.

Although some progress has been made in integrating population into development planning, the progress has been rather slow. This has been due both to the limited knowledge base relating to diverse population processes and to a likelihood that planning structures and approaches had acquired rigidities that precluded taking into account the needs of population planning. Although the importance of population factors to development planning has been recognized, the interrelationships between population and development have still not been adequately appreciated. The whole field of integration is still in the experimental stage and there is no guarantee of its success in every situation.

The creation of a strong population planning body close to the centre of governmental power and supported by adequate resources could provide the



necessary impetus for the integration and success of population and development programmes. This should ensure that economic growth, social development, family welfare and family planning programmes are mutually supportive.

### Summary

It is likely that during the next decade demographic patterns and trends will continue to exert strong pressure on national development. For example, in most developing countries increased internal migration is likely to aggravate the imbalance between the spatial distribution of population and labour force and resources. High rural-urban migration trends will continue to aggravate housing shortages, unemployment and overcrowding in large cities.

It is also likely that disparities in terms of income, employment and living and working conditions among countries, especially between the least developed and the developed, will encourage international migration and may create a number of problems in the countries of departure as well as in the receiving countries.

Insufficient education, low income and the absence of basic health care and other necessities such as drinking water and food will slow mortality decline, in particular infant mortality decline, in many countries in Africa, Latin America and Western Asia.

Rapid growth of population continues to exert great pressure on the development of a number of countries, especially in Asia, because of their important population size and the relatively low development potential of resources. Study of the interaction between family planning programmes as a means of curbing population growth, and social and economic development factors, for example, education, participation in the labour force, household income, development of resources etc., should be part of country activities for the next decade.

The need to formulate adequate population policies, based on national development priorities and taking into account the interaction between population change and social and economic variables, is becoming more and more necessary. The establishment of high-level government institutions, such as national population commissions to define adequate population policy in the context of national development planning, should be given more priority. It is also necessary to establish population policy and development units to provide technical advice and basic information through research and studies to the national population commissions. These units can also provide technical advice to ministers of planning and other departments on the integration of demographic factors and population policies into development programmes.



Notes

1/ Review and Appraisal of the World Population Plan of Action (United Nations publication, Sales No. E.79.XIII.7), annex I, para. 95.

2/ "Integration of population and development policies: A comparison of the developing regions of the World" (Special Paper No. 12), presented at the ESCAP Third Asian and Pacific Population Conference, Colombo, 20-29 September 1982, p. 14.

3/ Gavin W. Jones, "Review of the integration of population and development policies and programmes in Asia" (Background Paper No.1), presented at the ESCAP Third Asian and Pacific Population Conference, Colombo, 20-29 September 1982, pp.8-9.

4/ Ibid. p. 10.

5/ Ibid. p. 14.



### III. RESOURCES AND ENVIRONMENT

#### A. Resources as a barrier to population growth (an analysis through 2000): an essay on explorations in alternatives

D.V. Ramana\*

##### Introduction

The impact of population on resource use and exhaustion derives its relevance to development and planning from the physical and economic scarcities of (natural) resources and from their upward sloping supply curves in juxtaposition to an increasing population whose marginal production costs are low as well as constant, if not decreasing. The supply of resources is not a given datum, but usually a positively related quantity-schedule with respect to prices, and on a graph it can shift upwards and to the right hand side in response to technological innovations. Even a quantum increase in the supply of specific resources in terms of a rightward shift of its curve is possible. But if at all, it does, come about rather rarely and only in response to land-mark technological improvements. Such prospects may, in some cases, be bright for a long-run relative abundance of specific natural resources, but in the short-run, they are beset with discontinuities. The supply responses of certain specific types of resources to scientific and technological innovations (petroleum for instance) are uncertain and relatively inelastic. The innovations themselves are discrete and unpredictable in their occurrence; and they rarely get disseminated uniformly to all the centres of production in the world. Short-term shortages of essential goods do occur as in 1973-1976, and these are compatible with a notional or real long-run plenty.

Moreover, natural resources are not merely minerals; they also comprise sea-based and land-based resources such as fisheries, forests, grasslands and croplands whose supply is more limited and less elastic with respect to productivity and prices, and less prone to shifts as a result of technology.

The demands of population growth on the exhaustive <sup>1/</sup> use of resources, both sea-based and land-based resources and mineral resources (the latter to a lesser extent in the short-run), are direct, immediate and obvious. An increase in the number of human beings extends their margins of exploitation too fast and too indiscriminately so that degradation sets in. And such degradation becomes accelerated when, as often happens, no adequate provision is made for replacement.

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\* Formerly of the United Nations Asian and Pacific Development Institute, Bangkok.



It is, therefore, possible to argue that the differential quantitative impact of population on the productive use of resources through the growth of gross production is close to zero. The world gross product is expected to increase by 230 per cent during the period 1975-2000, and the world's population by about 55 per cent in the same period. The expected income growth could remain very likely about the same whether or not population grew at the same time, because the size of the population, as it existed say in 1980, could supply adequate labour inputs and skills for the expected increase in the gross world product by the year 2000. Should such be the case, the marginal contribution of the population (i.e., the contribution of the additional future <sup>2/</sup> population) to the world gross product might be negligible. The additions to the population would then only share what would be there anyway by way of gross product. This would happen, anyway, for the period up to the year 2000 and somewhat beyond that period into the twenty-first century as a result of the momentum for population growth that is already built into the existing numbers and their age distribution. But, one may ask, should such a state of affairs continue for a long period beyond a point when the existing potential for population growth gets dissipated? Should the world not be free to choose the magnitude of its human population and then seek to maintain it? These questions gain in urgency and crucial importance as the limits to the carrying capacity of the world's biological systems are approached.

This paper first briefly describes the population and resource trends through the year 2000. It then outlines the key issues embedded in the interaction of population and resources. Finally, few pointers are given on a possible framework of policy for a more imaginative management of resources and population.

#### Population and resources: likely trends to the year 2000

##### Population

It is estimated that world population will increase by 2.26 billion from 4.09 billion in 1975 to 6.35 billion in 2000. The increase is enormous by historical standards and is approximately equal to the total world population itself in 1950, at 2.49 billion. It may be seen from these figures that, from 1950 to 2000, the world population increase amounts roughly to 4 billion or over 150 per cent. This is an unprecedented demographic event. Its impact on the biological and socio-economic systems of the world is substantial, and will be felt long after the year 2000, even if further population growth came to an abrupt stop thereafter. That, of course, is not going to be the case. Indeed, the attainment of a state of stationary population some time during the next century is expected to be at a level of 12 billion. As such, the population increase with which demographers and development planners are confronted is of the order of 10 billion from 1950 through a time span of 100 years or so.<sup>3/</sup>

Unavoidable numbers. A part of the problem is that the population figures for the year 2000 cannot be made to change very much no matter what policy expedients might be used.<sup>4/</sup> A global population of 6 billion for 2000



seems unavoidable, barring a large scale catastrophe. The world population growth rate is expected to decline by only one tenth of one per cent from 1.8 in 1975 to 1.7 in 2000, the "sticky-down" of the growth rate being mainly due to the age distribution of the population in which the young predominate and the females of reproductive age are expected to increase by 64 per cent during the period 1975-2000. Even a reduction of fertility rates to replacement levels is of no consequence to the growth momentum of the population through 2000. But, in point of fact, the world fertility rates are expected to drop only by 23 per cent, from 4.3 children in 1975 to 3.3 children in 2000. And, moreover, the impact of this reduction on the total population will be offset by the likely increase in life-expectancy by 11 per cent, to 65.5 years in 2000 from 59.5 in 1975.

Population distribution between more and less developed countries. A notable fact of this unfolding demographic picture is that 92 per cent of the growth of the world population during the period 1975-2000 will take place in the less developed countries. The population of the LDCs will be 5 billion in 2000, representing a growth of over 200 per cent in a 50-year period. The relatively greater prolificity of the population in the LDCs has implications for resource use. As the LDC practices of land maintenance and resource replenishment leave much to be desired, the considerable increase of population that has already taken place in these countries has led to desertification, soil erosion, deforestation, loss of soil fertility, waterlogging and salinization of the soil. Some details of these types of degradation of resources are given below.

Desertification the world over is estimated at 6 million hectares per annum of which the share of the LDCs is over 80 per cent.<sup>5/</sup> The suspended load per square kilometre of drainage basin, as an indication of soil erosion, is three to eight times more in the LDCs than the world average.<sup>6/</sup> The annual decrease in operable forest area is about 2 per cent in most of the LDC regions.<sup>7/</sup> A staggering 89 per cent of the world soil resources are affected by factors such as drought, mineral stress, shallow depth, excess water and perma-frost, and most of these are found in the LDCs, especially in Asia. Salt-affected soils are estimated to be 85 million hectares in South Asia, 212 million hectares in north and central Asia and 20 million hectares in Southeastern Asia. Large areas of irrigated land have had to be abandoned as a result of soil salinization. To make them productive, improved drainage should be extended to an area of 42 million hectares of irrigated land in Asia much of it requiring improvements in the irrigation system itself. A typical case of waterlogging and salinization obtains in Pakistan. The gross command area under canal irrigation in the country is about 37.5 million acres, of which the total irrigated area is 29 million acres. Seventeen million acres of agricultural land were affected by soil salinity before remedial measures were initiated.<sup>8/</sup>

The Global 2000 Report observes:

"The situation in Pakistan is far from unique. In Afghanistan, waterlogging, salinization, and alkalinization are evident in most agricultural areas. In Argentina, 2 million hectares of irrigated land are adversely affected by water-logging, salinization, or



alkalinization. And in Peru, 300,000 out of 800,000 hectares of coastal irrigated land are affected by salinization or water logging. In fact, virtually every nation with a sizeable irrigated area is now adversely affected by these problems."9/

While chemical degradation affects 23 per cent of the world's soils, the proportion for Southeastern Asia is as high as 59 per cent, being indeed the highest in all the regions of the world. The soils of Southeastern Asia are poor in nutrients because of their senility and their weathering in situ under the influence of climatic and biotic factors. They have low nutrient-holding or water-holding capacities and a high level of acidity.

An additional factor which has serious implications for land maintenance is shifting cultivation practised the world over by an estimated 200 million people in 1960 and 300 million in 1980 thinly scattered over 36 million square kilometres of the tropics. The numbers seem to be on the increase as a result of the growth of population while the spread of modern ways of life are interfering with the pattern of shifting cultivation as practised in the past. The projected increase of the number of people engaged in this type of cultivation by 50 to 70 per cent by the year 2000 will lead to the increased use of marginal and sub-marginal lands with the attendant risks of steep slope erosion, increased flooding and siltation and loss of land productivity up to 90 per cent.

The above vulnerabilities have an upward bias not only because proper maintenance and replacement practices are not adopted in the LDCs but because of the sheer growth of population. The unusual severity of the drought in Sahel, for example, during 1968-1973 was due to the collapse of carrying capacity precipitated by the growth of human and animal population, which has doubled in the last 35 years. The FAO observes that the global livestock population growth has led to "the serious deterioration of grazing land, particularly in the Sahelian and Sudanian zones of Africa, and in parts of the Near East, the Mediterranean and North Africa. The grazing resources in these areas are to a large extent under-arid and semi-arid conditions, and some of them have already been threatened for hundreds and sometimes thousands of years by overuse, leading to complete changes in the vegetation, which have left only shrubs of low palatability. Further increases in grazing pressure and aggravated misuse result in the complete devastation of all vegetation, which finally ends in desertification. The problem has been magnified by the encroachment of cropping into the grazing area, as a result of faster population growth outside the range area. Similar problems exist in other arid and semi-arid areas, for example, in continental Eurasia, in India and Pakistan, and in Northeast Brazil."10/

Similarly, with the six-fold increase of the population of North Africa since the beginning of the century there has been accelerated destruction of vegetation in Algeria, the Libyan Arab Jamahiriya, Morocco and Tunisia. The result is that more than 250,000 acres of farmland in North Africa are lost to the desert each year.

While the concentration of the growth of population in the LDCs has led in the past and will lead in the future to considerable deterioration of



forests, fisheries, grasslands and croplands, the high standard of living and the nature of its composition in terms of goods and services and the associated techniques of production employed at the level of the firm have contributed, in the more developed countries, to a profligate and exhaustive use of resources. As the Cocoyoc Declaration states:

"Population growth is, of course, one element in the growing pressure on world supplies. The planet is finite and an indefinite multiplication of both numbers and claims cannot be endlessly sustained. Moreover, shortages can occur locally long before there is any prospect of a general exhaustion of particular resources. A policy for sane resource conservation and for some forms of management of ultimately scarce resources within the framework of a new economic order must soon replace today's careless rapacity. But the point in the existing world situation is that the huge contrasts in per caput consumption between the rich minority and the poor majority have far more effect than their relative numbers on resource use and depletion. We can go further.

Since a lack of resources for full human development is, - as the Bucharest Conference on Population clearly recognized -, one of the continuing causes of explosive population growth, to deprive nations of the means of development, directly exacerbates their demographic problems."11/

As an illustration, a measure of international inequality is given by differential income levels. For instance, in 1974 the GNP per capita of the United States was 66 times the GNP per capita of Bangladesh. In general, the developing country per capita incomes as a per cent age of developed country per capita incomes have declined from 11.9 in 1950 to 9.7 in 1960 and 9.2 in 1975. Associated with this trend were the number of absolute poor in 1975 of 750 millions in the more developed countries, infant mortality was 128 per thousand in the poorest countries and 16 in the more developed countries; life expectancy in the poorest countries was around 50 and in the more developed countries around 72; adult illiteracy was 62 per cent in the poorest countries and 1 per cent in the more developed countries; and there were 50,000 people per physician in the poorest countries, while there were 700 in the more developed countries.

The extent of inequality in resource use is also equally well reflected in consumption patterns. In 1975, the per capita consumption of grain was 150 kilogrammes in India and 708 in the United States, nearly a multiple of five. As a multiple of the per capita consumption of the coal equivalent of energy by Bangladesh in 1974, the United States per capita consumption was 370 times more; and as a multiple of the per capita steel consumption of Indonesia in 1971, the United States per capita consumption was 123 times more (see table 1).

Two caveats must be entered in connection with inequalities in the consumption standards of the less and more developed countries. One relates to the argument that the inequalities are between the poorer and richer sections of a community everywhere and not necessarily between the less and more developed countries. This is true; however, there are many more richer



people in terms of the world average per capita income in the more developed countries than in the less developed countries. The other point that is often made in this context is that the commodities that are produced more resource intensively in the more developed countries are consumed everywhere through international trade. This is also true; but the commodities that are produced less resource intensively by the less developed countries are also consumed everywhere through international trade.

Age distribution of the population. Given the projected change in population between 1975 and the year 2000, the number of dependent population will increase from 1.7 billion to 2.4 billion in 2000; and the number in the working age group (15-64 years) will increase from 2.4 billion to 3.9 billion. Proportionately, the dependent population will fall from 42 per cent of the total in 1975 to 38 per cent in 2000; and the working age population will increase from 58 per cent in 1975 to 62 per cent in 2000. An obvious implication of the growth of the numbers in the working age group is that, on the basis of a proportion of two thirds of the working age group in the labour force, there will be a labour force of approximately 2.6 billion in 2000 as compared with 1.6 billion in 1975 and 1.8 billion in 1980, and the ILO projection of 2.0 billion in 1985. These numbers represent an approximate 2 per cent average annual rate of increase in the labour force, calling for a 6 per cent annual growth of the GNP for the world as a whole, on the assumption that the employment coefficient of output is about 0.3. Assuming a marginal capital-output ratio of 3.0 for the world as a whole, the investment required to promote incremental employment for the expected numbers in the labour force is 18 per cent of the world gross output. Additional to those needed for generating employment, the investments necessary to safeguard and promote the welfare of dependants (for the provision of health, education, etc.), based on a conservative estimate for the social infrastructure component of 40 per cent of the total investment, will be an additional 12 per cent of the world gross output. Taking into account investments needed for modernizing equipment and improving the quality of capital as well as for building up the technical capability for producing newer and more capital intensive goods on a continual basis, another 10 per cent of the gross world product may need to be added to the total annual global investment, apart from the investment resources required for employing labour for these purposes. Thus the total investment provision may have to be in the order of 40 per cent of the gross world product; in other words, the extended marginal capital output ratio must increase to about 7.0. This point has also been made by Leontief who observes:

"Accelerated development in developing regions is possible only under the condition that from 30 to 35 per cent, and in some cases up to 40 per cent, of their gross product is used for capital investment. A steady increase in the investment ratio to these levels may necessitate drastic measures of economic policy in the field of taxation and credit, increasing the role of public investment and of the public sector in production and infrastructure. Measures leading to a more equitable income distribution are needed to increase the effectiveness of such policies. Significant social and institutional changes would have to accompany these policies. Investment resources coming from abroad would be important but are secondary as compared to internal resources".12/



Urbanization. A special attribute of the growth of population in the twentieth century, especially in its latter half, is urbanization. In 1965, the urban population of the world amounted to 35 per cent of the total at 1.16 billion. The figure rose to 39 per cent in 1975 at 1.56 billion; and it is projected at 50 per cent in the year 2000 or 3.2 billion people. In the LDCs, urban population increase during the period 1975-2000 is expected to be 59 per cent of the increase in LDC population, or approximately an absolute increase of 1.2 billion. Adding this figure to the approximately 500 million urban population in the LDCs in 1975, there will be roughly 1.7 billion urban population in the LDCs by 2000, representing over 30 per cent of their total population. Most of the increase of 1.2 billion urban people in the LDCs during the period 1975-2000 will have to be absorbed by the existing cities which will be swollen to uncontrollably large sizes, with Mexico City, for example, containing 30 million people. Pressure on infrastructure and social services will become intense so that a progressively greater proportion of the urban residents will have to go without them. Slums and shanty towns may, therefore, account for most of the urban growth.13/

"Raw sewage, air pollution, lack of housing, poor and crowded transport, inadequate fire protection, and disease will present increasing difficulties within these cities. Immediately outside the cities, firewood gatherers, animal grazers, and charcoal-makers will strip the surrounding areas of accessible trees, shrubs, and grasses. As the area of degradation widens, there are likely to be losses of indigenous plants and animals, aggravated soil erosion, and increased risk of serious flooding".14/

International migration. An important aspect of population movements is the potential for international migration. The five countries in Asia with large populations, viz., China, India, Indonesia, Bangladesh and Pakistan with expected populations in the year 2000 of 1,329 million, 1,021 million, 226 million, 159 million and 149 million, respectively, account for 46 per cent of the world population. They will have an average density of 180 persons per square kilometre and together will represent the most densely populated region of its size in the world. Should for some reason, either in search of food or shelter or employment, a few scores of million of these people start migrating, reminiscent of the Vietnamese boat people to other less populated regions, the world will face a most cantankerous problem which no immigration laws can contend with, and no arms could be used against. The containment of the population of this region, within some acceptable limits, is perhaps one of the most urgent problems of the world, even more than the energy problem. On a more limited scale, within the Americas, the faster growth of population in Mexico and Latin America has implications for the international movement of population northwards; and within Europe, from Southern Europe to Northern Europe. Repressive political regimes, or protracted local wars, or localized food scarcities (not necessarily physical shortages but lack of exchange entitlement) can become triggering factors.



### Gross world product

The income generated by the world economic activity is projected to increase from \$ 6.0 trillion in 1975 to \$ 14.7 trillion in the year 2000 with a growth rate of 4.05 per cent per annum in the period 1975-1985 and a growth rate of 3.32 per cent in 1985-2000. The per capita income is expected to increase from \$ 1,500 in 1975 to \$ 2,300 in 2000. The growth rates <sup>15/</sup> seem to be inadequate to provide the requisite employment opportunities for the expected increase of the labour force. To do so would require an annual income growth rate of roughly 6 per cent, as mentioned earlier. Be that as it may, the projections of world gross product are made without taking into account the gathering resource scarcities and the added rigour of the constraints on development thereof. The Global 2000 Report admits that its world product projections (which are based on the World Bank projections) do not take into account the feedback from resources projections. "In particular, the population and GNP projections that are made in the first step are based largely on extrapolations of past trends and are uninformed by interactive feedback from the resource and environmental projections."<sup>16/</sup>

Should one take into account the tightening grip of the resource scarcities, it is possible that both the population and world gross product may not that easily reach the projected levels by the year 2000. In the case of population, the factors of resource scarcity-induced limits as well as a deliberate and volitional policy of family planning might rein the momentum of growth at least in the long run, and might in the short run, from now until 2000, lay the foundation for this effort. Fortunately, these two factors work in concert in matters of population policy. But, in the case of world product, while development policy and planning might try to maximize growth, ceteris paribus the resource limits might detract from that effort and run counter to the very purpose of development planning, which is to shift upwards the schedules of resources (or mitigate the rigour of the resource constraints).

### The reckoning of the outer limits

The Founex Report observes :

"Whilst the concern with human environment in developing countries can only reinforce the commitment to development, it could serve, however, to provide new dimensions to the development concept itself. In the past, there has been a tendency to equate the development goal with the more narrowly conceived objective of economic growth as measured by the rise in gross national product. It is usually recognized today that high rates of economic growth, necessary and essential as they are, do not by themselves guarantee the easing of urgent social and human problems. Indeed in many countries high growth rates have been accompanied by increasing unemployment, rising disparities in incomes both between groups and between regions, and the deterioration of social and cultural conditions. A new emphasis is thus being placed on the attainment of social and cultural goals as part of the development process. The



recognition of environmental issues in developing countries is an aspect of this widening of the development concept. It is part of a more integrated or unified approach to the development objective.

When the environmental problems of developing countries are in large measure those that have arisen from the lack of development, it is also true that problems arising out of the process of development are also in evidence in these countries....

The problems are already severe enough in developing countries. But in the absence of resolute action, they will tend to attain formidable dimensions in the decades ahead. The very growth of population, when not accompanied by adequate economic development, brings out the prospect of rising unemployment, further impoverishing the countryside and swelling the drift to the towns and creating human problems of the deepest intensity. They can only aggravate the serious social and political tensions that even now prevail in these societies. There can indeed be little doubt about the urgent need for corrective action."17/

Such corrective action should be taken in the light of two sets of factors. First, it should be clearly realized that most LDCs have made an honest attempt to promote development during the last three decades; and some of their policy measures like land reform have been worthwhile and their implementation should be carried further in the future. Second, it should also be borne in mind that the end-results of overall policy have not always been creditable. Though changing development fashions led to policy shifts from time to time, in the course of conceptualizing and engineering these shifts little attention was paid to foundational issues such as human resource degradation, natural resource degradation and a considerably uneconomical and wasteful use of reproducible capital. Quite often the approach to the highly complex set of social problems remained limited to economic initiatives and the associated policy action was dominated by the prescriptions of economists. This economic approach to development planning did not always adequately emphasize the economics of development nor was it able to cope with structural issues as they arose. It is well known that during 1973-1976 there was a global crisis, and the economist was "caught with his parameters down", so to say, because he neglected the environmental (biological) limits or the carrying capacity constraints. Such crises can recur, and probably with increasing frequency in the future, and the policy to cope with them should be elaborated with a view to the outer resource limits. A few potential sources of these limits are described below.

Fisheries. The case of fisheries is often cited as one in which a biological barrier has already been struck. Data on world fish catch over the years from 1950 seem to support this view, and draw attention to the broader implications for the earth's carrying capacity. The total fish catch, which was 21 million tons in 1950, grew steadily to 70 million tons in 1970 and stayed put at that level or just below it until 1974. In 1975 the catch was 71 million tons. It registered an increase to 74.7 million tons in 1976 and then went down again to 73.5 million tons. The catch for 1978 was 72.4 million tons. The vigorous growth of the earlier years could not be re-established in spite of heavy additional investment and rationalization of the fishing industry. One reason for the sticky 70 million tons of fish catch



is the over-exploitation of the anchoveta fishery in the Southeast Pacific whose production declined by about 10 million tons from 13.5 million tons in 1970 to 3.5 million tons in 1976. In particular, fluctuations in the catch of anchoveta and other shoaling pelagic fish have had a marked effect on the level of world fishery production. They sharply boosted the rate of increase during the 1960s and caused it to level off in the 1970s as catches declined because of heavy fishing and depletion of stocks. Though aquaculture which contributed an estimated 6 million tons in 1975, has the technical potential of a manifold increase, it cannot reasonably be expected to contribute more than 12 million tons by 2000 in view of limited investments as well as the increasing pollution of fresh water ponds. The most optimistic projection of ocean fisheries is for 100 million tons a year in 2000. Even at this unlikely 18/ figure, the per capita fish supply will be less in 2000 than in 1975. According to one estimate, the per capita fish catch will fall to 16.6 kilogrammes in 2000 from 19.5 kilogrammes in 1970 (see table 2). In point of fact the fisheries of the world can supply the protein needs of only 16 per cent of the world population in 2000 as against 25 per cent in 1975.

Forests. A biological barrier which operates more at the local (regional) level than at the global level is forests. Closed forests and open woodlands together cover 32 per cent of the world land area. But, they are not evenly distributed. For Asia in particular, they cover only 19 per cent of the land area, the lowest of the seven regions into which the world is divided for the purpose of a comparative study of the future of forests. The low share of the land area, taken in association with the large population of Asia (56 per cent of the world population), gives only 0.2 hectares per capita of closed forests. The highest is 4.2 for Oceania. Next in order come the Union of Soviet Socialist Republic with 2.7; Latin America with 2.1; North America with 2.0; Africa with 0.5; and Europe with 0.3. The world average is 0.7. Even in regard to growing stock, there are wide variations, Asia having 27 cubic metres per capita and Latin America 428 cubic metres.

The forest area is relatively stable for the more developed countries and is expected to remain so in the year 2000. In the case of LDCs, however, which together have 1.1 billion hectares of closed forest, it is being consumed at the rate of 20 million hectares per year. About two thirds of the forests are economically accessible, and at present rates of consumption, together with lack of proper management, and the expected growth of population, these are likely fully to disappear by 2000, mostly because of clearing land for food production. The Green Revolution has caused only about 50 per cent of the increase in food supply. The other half has come from expanding the area of cultivation. At the same time, the growth of population and expanding GDP would more than double the consumption of forest products. For instance, the consumption of fuelwood will increase by about 70 per cent, simply as a function of population growth.

An unavoidable impact of the growing scarcity of forests (albeit at the local or regional level) is a substantial rise in the price of forest products. The World Bank observes that in the Sahel,



"As a result of progressive deforestation, rural household members have to walk farther and farther to collect fuelwood in some areas, almost half a rural family's working time can be spent gathering supplies. Meanwhile the average urban household, which uses between 3 and 5 cubic meters of wood a year, spends an increasing part of its budget on fuelwood. In some Sahelian towns, it often 'costs more to heat a pot than fill it'."19/

Thus, rising costs and decreasing supplies everywhere seem to characterize the scenario of forests for the year 2000. The world over, the closed forest area is expected to decline from 2.5 billion in 1975 to 2.1 billion hectares in 2000. In Asia, it would halve from 361 m. hectares in 1978 to 181 m. hectares in 2000. The growing stock for the world as a whole will decline from 327 billion cubic metres overbark to 253; for Asia, the decline will be 50 per cent from 38 billion to 19 billion.

The growing shortages of wood for fuel and building in large regions of the world can act, at least in respect of rural energy supplies, as a binding constraint on development, especially so if, in the same regions, the population size and its rate of growth were to be large as they actually happen to be, for instance, in Asia.

Grasslands. In most of the world, especially in the LDCs, human and livestock populations have a tendency to grow together. The FAO estimates that the world over, cattle grew at an annual percentage rate of 1.8 between 1955 and 1976, from 878 million to 1,214 million; and they are projected (on a linear basis) to increase to 1,598 million in the year 2000. Sheep and goats grew at 1 per cent per annum during 1955 and 1976 from 1,201 million to 1,451 million and are expected to be 1,736 million in 2000. The Winrock projections, based on feed availability calculations, give alternative estimates for 2000 of 1,604 million cattle and 2,005 million sheep and goats. The livestock populations are largely concentrated in the grasslands of central Asia, Africa, Oceania and Latin America. These are already heavily in use and face the prospect of significant denudation due to the growth of livestock. Denudation is almost always accompanied by increased soil erosion.

"Many of the world's densely populated regions - such as Western India, Pakistan, Nepal, northern China, North Africa, the Middle East, and the Andean regions of South America - face ... severe over-grazing and subsequent erosion of their soils by wind and water. Over the past thirty-five years, human and livestock populations along the sub-Saharan fringe have multiplied rapidly, nearly doubling in some areas. Populations in Mali, Niger, the Sudan, and Ethiopia are increasing by 3 per cent yearly. The results are overgrazing and deforestation, which encourage the advancement of the Sahara desert along parts of its southern fringe from Senegal to northern Ethiopia, and the degradation of land quality in a large semi-arid zone to the South".20/

Despite the sizeable increase in the number of cattle and sheep and goats, their products per capita of the human population have not been increasing (see table 2). This may be taken as an oblique indication that, while the numbers of animals have grown, their per unit productivity has been



generally on the decline. The grazing commons, the rangelands etc., have not been able to sustain the growing number of animals with equal ease and comfort as before when the numbers were fewer. The carrying capacity of the grasslands is, therefore, another biological limit which seems to have already been reached. The expected increases in the animal population in the future call for improved methods of rangeland management to avoid the "tragedy of the commons", which arises out of individual self-interest becoming detrimental to the long-term welfare of a whole society using a common facility.

Croplands. The carrying capacity of croplands also seems to be under progressively increasing stress. With the growth of world demand for food and fibre the elasticity of which with respect to population and income is approximately unity and a range of 0.15-0.3, respectively (the latter varying greatly between countries and regions of the world), the croplands may become a major concern. World food supplies are expected to increase at an annual rate of 2.2 per cent during 1970-2000, with supplies in 2000 being about 90 per cent more than supplies in 1970. Most of the increase in food production is expected to come out of increased yields rather than an extension of the margin of cultivation. Actually, land under cultivation is projected to increase only by 4 per cent between 1970 and 2000. The increase in the yields will be realized only at progressively higher costs. The real cost of producing food went up considerably everywhere during the 1970s (in 1978-1979 alone, the real cost of producing food in the United States increased by about 10 per cent).

An indirect measure of the pressure on croplands is decreasing food reserves, both in terms of food-stocks and idled croplands. Measuring the two in millions of metric tons, the food reserves decreased from 222 million tons in 1961 to 90 million tons in 1974, while food prices in the same period went up by about 400 per cent. This trend is confirmed by the expected decrease in arable area per capita, which was 0.48 hectares in 1951-1955 and is projected to decline by about 50 per cent in 2000 to 0.25.

Part of the above decrease in the arable area per capita is brought about by urban development which often expropriates the best available irrigated land. These losses of cropland to urban development are estimated to amount to 2 per cent of the world crop base in the year 2000. These losses may be more in LDCs where housing is often limited to one-storey structures.

Overall, the pressure on croplands and the demands on their carrying capacity arise not merely from the increase in population and GNP but also from the cumulative impact of the past neglect of land which, as mentioned earlier, has caused desertification, water logging, salinization and alkalinization, deforestation and general erosion and humus loss.

Energy. Before 1973 the demand for energy was growing proportionately to GDP in the more developed countries, and somewhat faster in the less developed countries. Yet, the LDCs today account for only 14 per cent of the total consumption of petroleum, 25 per cent or so of their energy consumption needs being met by renewable sources of energy. The productive efficiency of the supplies from renewable sources is less than that of petroleum,<sup>21/</sup> so much so that the total energy cost of a "normalized" commodity is more in the LDCs than in the more developed countries (see table 3).



The expected growth of energy consumption in the future from renewable sources, though not necessarily from non-commercial sources, may lead to inefficiencies in the production process of almost all commodities, energy being an input in the nature of a universal intermediary. For the petroleum production per capita is expected to drop from a high of 5.29 barrels in 1979 to 3.55 barrels in the year 2000 (see table 4).

And one form of renewable energy, fuelwood, is going to be in short supply.

"While prices of oil and other commercial energy sources are rising, fuelwood - the poor person's oil -, is expected to become far less available than it is today. The FAO has estimated that the demand for fuelwood in LDCs will increase at 2.2 per cent per year, leading to local fuelwood shortages in 1994 totalling 650 million cubic meters - approximately 25 per cent of the projected need".22/

An emerging issue in energy planning for the low-income non-commercial energy users is the extent of land which would be committed to energy crops for alcohol production. Should private cars have to be powered by alcohol in the LDCs, the area of cropping land to be committed would be unconscionably large (see table 5). The increasing population and the associated increasing demand for energy (with an income and price elasticity of demand of 1.0-1.3 and 0.2-0.6 respectively) will make it necessary to seek additional supplies from energy crops, now that the nuclear dream remained what it always has been, a dream".23/

Water. The increases in population and GDP as well as the changing composition of the GDP with the production of goods needing a technically more roundabout process imply fast-growing demand for water withdrawals, amounting to an increase of 200 to 300 per cent over the 1975-2000 period. The demand for water for irrigation is likely to be the largest and fastest growing component of the world water demand.

The water scenario for the future is characterized by regional water shortages, especially in densely populated regions such as South Asia and the Middle East. The increase in the price of energy will make the cost of developing water supply, especially for irrigation, enormously large. And development of irrigation is bound to remain absolutely essential in view of its potential benefits in terms of agricultural production and more efficient land use. The global costs of new irrigation works is estimated to be \$ 60 billion at 1975 prices.

Access to safe drinking water in the LDCs may become in the year 2000 even more remote than now as available investment resources become more scarce. In a survey conducted by the World Health Organization (WHO) in six WHO regions of the world, all of them, except Europe, reported that the insufficiency of internal investment resources was the most rigorously constraining factor in providing safe drinking water to people.

While making investments for water supply and distribution systems, it may be prudent to accord preference to the development of water grids on the lines of the proposed Indian National Water Grid. Its proposed plan



"covers the entire Indian Peninsula and is estimated to cost over \$ 4 billion. The project would link all the major rivers of India - the Ganges, Brahmaputra, Narmada, Tapti, Godavari, Krishna, Pennar and Kaveri. The core of the country's national water grid will be the Ganges-Cauvery Link Canal. The grid will extend from Assam in the east to Rajasthan in the west and Tamil Nadu in the south. The plan envisages the lifting of 25 thousand million m<sup>3</sup> of water annually from the Ganges 460 m up into a reservoir. From the reservoir, the water will course its way across the Deccan plateau through a 3,300 km. network of aqueducts, gravity canals, tunnels, natural watercourses and reservoirs and flow into southern and western rivers ... The grid concept may be worthy of study and application in other countries and regions. Some significant results have been obtained in Israel with the application of this idea".24/

Other mineral resources. The supply of mineral resources for accelerated development is not really a problem of absolute scarcity, but one of having to do with more inaccessible sources and their inferior productivity. It is also a problem of rate and magnitude in respect of reserves of certain minerals like lead, zinc and copper, the recoverable potential and the crustal mass of which are, however, considerable. The prices of these minerals as well as others are likely to rise on the average about 200 to 300 per cent between now and the year 2000. Zinc, for instance, is expected to rise from \$ 0.23 per pound in 1976 (in 1970 US dollars) to US\$ 0.62 in 2000.

The concern about mineral resources is more a matter of rising cost of mining inferior sources and a consequent rise in price than of constant or diminishing supplies. As Nordhaus put it:

"For centuries there has been virtually constant concern about the availability of mineral resources. Many recent studies have kindled this anxiety by showing that the ratio of proved reserves to current consumption ... for most minerals is very low. Fortunately, this is unduly pessimistic because the concept of reserves is entirely different from ultimate recoverable resources. At the opposite extreme it is possible to calculate the total crustal abundance ... of different materials; of course this is unduly optimistic because it assumes that everything can be recovered. Somewhere between the two concepts lies the economically relevant measure-ultimate recoverable resources. Although URR is a variable which depends on technology and price, we can at a first approximation use recent estimates prepared for the U.S. Geological Survey. These assume that URR is approximately 0.01 per cent of total availability to a 1-kilometer depth...

The clear evidence is that the future will not be limited by sheer availability of important materials; rather any drag on economic growth will arise from increases in costs ...

Pretty clearly, the sheer adequacy of energy resources depends on whether certain future technologies will become available. Even with only the current technology ... there are resources for more than 8,000 years at the current rate of consumption. With breeder reactors, and more dramatically with a fusion technology, there is virtually unlimited energy available."25/



### Some general observations

From the above review of population and resource trends, it is possible to make certain general observations.

Outer limits to growth and development arising out of physical resource inadequacies are quite elastic; their rigour can be substantially mitigated in the long run by scientific and technological innovations. However, there may be considerable time lags between encountering the drag on development caused by a specific resource limitation and devising a technological innovation which is designed to eliminate the limitation.

There may also be a time lag involved, rather longer than shorter, in the dissemination of technological innovations. While technological breakthroughs might shift the resource schedules upwards in the long run, the immediate and short-term tasks are to make substantial adjustments and improvisations in coping with the resource constraints.

The technological lags are likely to be longer in the case of LDCs either because certain types of technological innovations such as breeder reactors are unsuitable to them under the existing conditions or because the type of innovations that are relevant to their needs may come about more slowly because of a shortage of capital or the lack of national and international political will, or both.

The massive poverty of the LDCs and the consequent inability of these countries to mobilize physical resources for development or to maintain them suitably poses a special problem. It should be tackled on a priority basis, not least because elimination of poverty might lead to faster stabilization of population size.

Though inner and outer limits to growth and development operate in all countries, the inner limits arising out of political naivete, social rigidities, attitudinal archaism and institutional irrelevance seem to exercise their influence more rigorously in the LDCs than in the more developed countries.

A realistic analysis of the resources-population issue is best carried out on a specific country-by-country basis for identifying the local outer limits and assessing their relative strength vis-à-vis the inner limits.

The real problems underlying the population-resources regression are: the spectre of diminishing returns; the inadequacy of reproducible capital; the miasma of poverty and consequent human degradation; and the uneven spread of technologies and barriers to their transfer to the LDCs.

### Certain key issues in the population-resources regression

Adverting on the resources constraint on development, Robert M. Solow observes that the issue is one of substitutability of reproducible capital for natural resources.



".... the degree of substitutability is also a key factor. If it is very easy to substitute other factors for natural resources, then there is in principle no 'problem'. The world can, in effect, get along without natural resources, so exhaustion is just an event, not a catastrophe ... If, on the other hand real output per unit of resources is effectively bounded - cannot exceed some upper limit of productivity which is in turn not too far from where we are now - the catastrophe is unavoidable. In between there is a wide range of cases in which the problem is real, interesting, and not foreclosed. Fortunately, what little evidence there is suggests that there is quite a lot of substitutability between exhaustible resources and renewable or reproducible resources, though this is an empirical question that could absorb a lot more work than it has had so far.

Perhaps the most dramatic way to illustrate the importance of substitutability and its connection with Doomsday, is in terms of the permanent sustainability of a constant level of consumption. In the simplest, most aggregative, model of a resource-using economy one can prove something like the following: if the elasticity of substitution between exhaustible resources and other inputs is unity or bigger, and if the elasticity of output with respect to reproducible capital exceeds the elasticity of output with respect to natural resources, then a constant population can maintain a positive constant level of consumption per head forever. This permanently maintainable standard of living is an increasing, concave and unbounded function of the initial stock of capital. So the drag of a given resource pool can be overcome to any extent if only the initial stock of capital is large enough. On the other hand, if the elasticity of substitution between natural resources and other inputs is less than one, or if the elasticity of output with respect to resources exceeds the elasticity of output with respect to reproducible capital, then the largest constant level of consumption sustainable forever with constant population is - zero. We know much too little about which side of that boundary the world is on - technological progress aside - but at least the few entrails that have been read seem favourable."26/

While the above observations are theoretically feasible two points need to be made in support of the argument. In the course of development, and along with the wider variety of goods that inevitably get produced, the versatility of reproducible capital will improve. Hence, it should be possible to substitute reproducible capital for natural resources more and more so that at some point the concerned elasticity of substitution becomes greater than unity. It also follows therefrom that the elasticity of output with respect to reproducible capital will increase in course of time, and at some point will exceed the elasticity of output with respect to natural resources. While the quality of reproducible capital gains in course of time, the quality of natural resources suffers as a result of resorting to inferior sources of supply.

But, the difficulty is really in accumulating reproducible capital to the required extent. The growth of population and the consequent increase in consumption make it harder and harder to avoid the constraint of investment (savings) resources.



### Capital shortage

In point of fact, the global income growth targets for 1975-1985 were originally placed at an annual percentage of 4.08, and for 1985-2000 at 3.32. Low as they were, they were further reduced in view of the recent downward revision of the growth rates of the countries of OECD and their downward pull on the growth rates of the rest of the world. Thus, the projected global rates of growth will not materialize, the reasons for it being high petroleum prices and lack of resources for capital formation, or the irrelevance of the existing capital which often shows up in the form of idle capacity.

The Business Weekly pointed out in 1975 that during the decade from 1965 to 1974, capital formation in the United States of America had amounted to \$ 1.6 trillion, substantially less than what would be needed for the next decade. The New York Stock Exchange estimated that capital requirements for 1975-1984 would reach \$ 4.7 trillion, and that actual savings would amount to about \$ 4.05 trillion, leaving a gap of \$ 650 billion to be reckoned with up to 1984.

"While the best available analyses on the projected scale of the capital deficit are those for the United States, the shortage is by no means confined to North America. Like inflation and unemployment, it affects the entire world. Even such efficient savers as the Japanese are running into difficulty. The centrally planned economies of Eastern Europe and the Soviet Union are collectively faced with a severe and deepening capital shortage; while borrowing heavily in Western capital markets, these nations are simultaneously scaling down their growth plans. The ailing economies of Britain and Italy also suffer from the inability to form enough capital. But if the problem is more visible in the industrial countries, it is more worrisome in the poor countries, where merely sustaining population increases requires heavy capital outlays".27/

New capital outlays are urgently needed the world over for financing the transition from oil to other energy forms, for irrigation and drainage, for capital modernization and for financing the growth rates of income that have become subjected to the operation of generalized diminishing returns arising from an imbalance of different kinds of capital. If the total capital stock of a community were to be broadly taken to include physical capital, human capital, institutional capital and natural resource stocks, and if the growth of population were at a rate of roughly 2 per cent per annum, the mere provision of amenities to transform the human population numbers into productive human capital would take away about a third of the available investment resources. Since the remaining investment resources would be inadequate for physical capital formation, the human capital would experience diminishing returns and tend to be underemployed. Similarly, the gathering of natural resources at unprecedented high rates would be subject to diminishing returns owing to the resort to inferior sources.



### Diminishing returns

A few illustrations of the play of diminishing returns are given below. The capital costs of the oil-importing developing countries' energy development programmes, including a doubling of domestic energy production, will be forbiddingly high. Around \$ 40 billion a year (in 1980 dollars) will be needed by 1985. Increasing reliance on higher cost supplies is likely to raise the average capital cost of energy production by a minimum of 50 per cent in the 1980s over that of the 1970s.<sup>28/</sup> Barry Commoner generalizes this issue thus with reference to United States oil supplies:

"... on both theoretical and empirical grounds it can be seen that, at least in the case of the best known deposits of a nonrenewable energy source, U.S. oil, the efficiency with which economic output is used to produce the energy falls exponentially as the resource is exploited. This defines the most crucial feature of the energy crises - that dependence on non-renewable energy sources with continued production diverts an exponentially larger fraction of total economic output into the production of energy. It means that the energy sector will, in effect, cannibalize the economic system which it is supposed to support".<sup>29/</sup>

Adverting further on the generalized operation of the law of diminishing returns, if the price of an essential resource (flow) is raised by fiat when its apparent cost of production is constant, the increased price gives a fillip to a continued production of substitutes until ceteris paribus their cost equals the price by fiat. What is more, even the resource whose price is raised will be sought to be produced from inferior sources until again its cost of production equals the price by fiat. Thus the initial price rise gets ingested by the body-economic through the equalization of opportunity costs and becomes irreversible; it spreads throughout the production process by the network of inter-industry relationships and becomes universal, especially if supply scarcities are expected to be progressively more acute.

Apart from energy, in the field of agriculture the law of diminishing returns operates with great rigour. In the United States between 1951 and 1966, the number of tractors increased by 63 per cent, phosphate fertilizers by 75 per cent, nitrogen fertilizers by 146 per cent, and pesticides by 300 per cent. Yet the crops, which may be taken as a good index of yield, increased by only 34 per cent. The returns to fertilizer inputs the world over have been diminishing dramatically. The ratio of incremental world grain production to the increment of fertilizer input was 14.8 in 1948-1952; 10.0 in 1959-1961; 8.2 in 1964-1966; 7.2 in 1969-1971 and 5.8 in 1974-1976.<sup>30/</sup> David Pimental reports that in the United States the return to inputs (all measured in kilocalories) in terms of corn production (also measured in kilocalories) fell from 3.70 in 1945 to 2.82 in 1970.<sup>31/</sup>

Diminishing returns have become operational in fishing and mining with equal rigour. The OECD estimated that in the six years prior to 1975 the total gross tonnage of the world's fishing vessels grew by more than 50 per cent, but during the same period the world catch of fish had hardly increased.



In regard to diminishing returns in mining, Leontief observes:

"The study took into account the fact that even in some cases in which mineral resources were relatively abundant in physical terms they will be more costly to extract in the future. As the more accessible reserves of particular minerals become exhausted, the next layer involving higher extraction costs begins to be exploited. Nor can we confidently assume that scientific and technological innovations would become operational in a timely and adequate manner to counteract the operation of diminishing returns".32/

### Poverty

A poignant result of population growth is the absolute poverty of large numbers of the people in the LDCs. Due to the paucity of resources in these countries as well as short-sightedness of development policy everywhere, given the population growth, the rate at which human beings are transformed into human capital has been steadily on the decline. Even apart from being unable to provide health, education etc. as instruments of human capital formation, the LDCs find it hard to feed the growing millions. In spite of some efforts (none too dramatic or systematic) to eliminate poverty (no concerted effort was made anywhere to promote human development; it was never given as an objective of development planning), the number of absolute poor is expected to be more in the year 2000 than now.

"While poverty could be reduced to low levels in the Middle Income countries by the end of the century, it will continue to plague the Low Income countries ... The proportion of the absolute poor in the total population is projected to decline by one-half in the Low Income countries ... The number of people in poverty declines only slightly because of the growth of population. This is a disturbing result, especially since the projected income growth rates for the Low Income countries are, if anything, somewhat optimistic. Given the obstacles they face, elimination of absolute poverty in the Low Income countries by the end of the century seems impossible."33/

The increase in the numbers of absolute poor is almost unavoidable in view of the pressure on cultivable land exercised by the growth of population. For instance, in Bangladesh which is already the most densely populated country in Asia, the projected agricultural population per 100 hectares of crop area will increase from 660 in 1975 to 980 in 1990, an increase of 48 per cent in 15 years (see table 6).

A consequence of such pressure on arable land and the rate of its increase has been growing landlessness. In Java, Indonesia, for instance, the landless labour was 21 per cent in 1963, and by 1973 it rose to about 50 per cent. Similarly, in Bangladesh, in the one and a half decades from 1951 it rose by 1.9 millions, from 1.5 millions in 1951 to 3.4 millions in 1968, at an annual compound rate of 5.5 per cent.



The increase in population and the associated growth of landlessness make the low-end income groups tragically vulnerable in times of food shortages, and an unpleasant visitation of Malthus becomes unavoidable in a sense. A telling instance of the impact of food shortages on the poor in an overpopulated country may be drawn from Bangladesh.

"A Ford Foundation analysis of the impact of the Bangladesh war for independence from Pakistan indicates that the actual loss of life in combat was rather small compared with the number of lives claimed by hunger ... The Ford Foundation report points out that daily per capita cereal consumption which averaged about 15 ounces during the sixties, probably fell to a near starvation level of 12 ounces in 1972. The data for Matlab Bazar indicate that the death rate climbed from an average of 15.3 per thousand for the 1966-70 period to 21.4 in 1971-72. An extrapolation to the entire country indicates a nation-wide increase in deaths of 427,000."<sup>34/</sup>

Apart from starvation deaths, the implied undernutrition in general plays havoc with the productivity and motivation to work of labour in general. It is well-known that the nutritional status of the mother sets the foundation for the growth of the child. During the early years, the required amounts of calories, vitamins and proteins help the child's body and brain grow. In the later years of one's life these also are prerequisites for the continued well-being and high productivity of labour. For instance, a World bank study in Indonesia in 1973-1974 showed that iron deficiency anaemia does affect productivity. Treatment of anaemia for a period of 60 days led to an increase in productivity of around 20 per cent for rubber tappers and 25 per cent for weeders. The report by the same World Bank group showed also that infections were much more common among these workers suffering from anaemia. Thus both absenteeism and actual physical capacity for output were related to anaemia. A small follow-up study in northern India where anaemia was not so severe, tended to confirm these results; only here, caloric status was found to affect output more than anaemia.<sup>35/</sup>

### Technology transfer

The efficiency of resource use can be raised by technology and the drag exercised by population growth on development can be eliminated by a timely and liberal use of technological devices. Unfortunately however, the availability of technology for the LDCs is neither timely nor liberal. To start with, the conditions necessary for the spread of technology do not seem to be very much present in the LDCs. There are internal socio-economic inadequacies and large-scale resource degradation which tend to create inhospitable conditions for the spread of technology. The non-agricultural activities in the LDCs, at least in the past, were mostly resource-exploitative in character and they did not have a built-in provision for husbanding or restoring the resource base. Even in the agricultural activities of these countries, land-water-soil management did not receive adequate attention owing to their neo-feudal landownership structures, inadequate political and administrative accountability, and the prevalence of land-use patterns that made land development practices relatively less attractive for the private enterprise.



A part of the reason why conditions are not conducive to an adequate and timely transfer of technology to the LDCs is the wide disparity in R & D expenditures, which in the more developed countries account for 97 per cent of the world total and in the LDCs for 3 per cent. What is more, the functional distribution of the R & D budget is such that the flow of benefits from these expenditures to the LDCs, even if there is a ready transfer of know how, is somewhat irrelevant to the major problems of the LDCs. Fully 32 per cent of the budget is spent on military and space research while basic research absorbs another 15 per cent.

The transfer problem cannot be wished away either. The more developed countries are not always willing readily to transfer the know how or share the benefits thereof. Skills or commodities are most likely to be denied when they are most badly needed. The international politics of development often spawns specific actions by the more developed countries which directly run counter to the interests of the LDCs. As an example, "The global food situation, already worrisome by mid 1973, was further aggravated by the energy shocks of late 1973 as the oil exporters exercised their new power derived from the seller's market for oil. Many oil-importing developing countries are now so strapped for foreign exchange that they will have to cut back on oil and fertilizer imports, which in turn may adversely affect their agricultural production for 1975. Even countries which have the foreign exchange may be unable to buy needed amounts of fertilizer. Fertilizer production was already inadequate to meet rapidly rising demand when energy shortages caused the Japanese to curtail their production. Giving priority to rising domestic needs and to exports to China, Japan cancelled contracts with developing countries calling for the shipment of nearly a million tons of fertilizer. The United States too is using more fertilizer as its farmers put more land under production and as the higher grain prices of the mid 1970s make it worthwhile to use more fertilizer per acre. As a consequence of increased demand in the United States, the Government and the fertilizer industry even agreed to halt further export sales for the balance of the crop year ending 30 June 1974 - with only limited export sales to the developing countries being resumed thereafter."<sup>36/</sup>

Thus the problem of capital shortage, the relentless operation of diminishing returns arising from imbalances in the capital structure, absolute poverty of large numbers as a thoughtless waste of human potential and the growing need for, and increasing difficulty of obtaining, technological fixes - these define the impact of growing population on resources.

#### Population and resources: towards a framework of policy

It is generally agreed that, in order to be effective and implementable, the solution to the population problem should be sought as an integral part of the solution to the problem of underdevelopment. A unified approach to development will carry population policy as one of its parameters. From the angle of the unified approach, development may be described as a movement of the social system in the direction desired by its people. Analytically, it comprises the following dimensions.



(a) The commodity composition of output and income should define a process which would ensure that a large segment of the income shall accrue to the low-end income groups. It may be necessary to stipulate that incomes of different income groups should grow differentially. That is, for instance, the incomes of people below a certain level of income (a minimum) should rise faster than the incomes of the people above the minimum.

(b) Methods of production which are employed should facilitate an augmented use of local resources.

(c) Levels and styles of living should contribute to an improvement in the productivity of labour either through augmented incomes or a more efficient delivery of public services or the creation of community assets by community participation, preferably by an appropriate combination of these.

(d) Institutions should change their structure and functions in order to become more realistic and more relevant to the needs of development.

(e) Attitudes should reflect the determination of the participants in the development process to bring about socio-economic change.

(f) Policies should permit the realization of the above five elements and mitigate the rigour of the inner and outer limits to development.

The wherewithal for development is resources - material, human and institutional. The management of resources implies actions that bring about an increase in their quantity, where possible; an improvement in their quality; a more efficient allocation; and resource provision for resource replenishment according to the depreciation 37/ provision. The problem of resource allocation should be viewed not merely in terms of production sectors but as an optimal (or as nearly optimal as possible) distribution of resources as between physical capital accumulation, human capital formation, institutional capital formation and natural resource development.

Recycling and reuse should become accepted practices on the widest possible scale, both in government and private activities of production (and consumption). Paper and glass are obvious candidates for recycling. The energy saved by recycling is substantial. For instance, it is estimated that recycling of steel saves 10 to 47 per cent of energy depending on the proportion of scrap used; aluminium 96 per cent; aluminium ingots 97 per cent; copper 88 to 95 per cent; glass containers 8 per cent; plastics 97 per cent; and newsprint 27 per cent.

"In addition to the energy savings ... the reuse of ferrous scrap by steel mills and foundries leads to an 86 per cent reduction in air pollution, a 76 per cent reduction in water pollution, a 40 per cent reduction in water use and a virtual elimination of solid wastes. Similar benefits are involved in the recycling of other metals."38/

Population planning should be combined with human development. It is vital to have targets for regulated population growth; and these targets should be spelled out in the development plans of countries. The



international development strategy should give a lead in this direction. Population planning should primarily focus on the widest possible spread of family planning services. Under the auspices of a national set of guidelines, the spread of these services should be the responsibility of decentralized politico-administrative bodies. Considerable attention, both at the national and international levels, should be given to devising ways and means of satisfying the basic needs of the people. It is a symptom of international rancour and mutual distrust of the more developed countries and the LDCs that basic needs have become high voltage politics. The status of women - mainly that of the fuel gatherers and water carriers: the human leftovers in the rural areas - should be improved. The people should be educated about the gruesome consequences of unbridled population growth. National economic and social policies should be oriented to the encouragement of small families as in China and Singapore.

By their very nature, resource management and human development warrant investment planning as well as consumption planning. For investment is essential for growth, and management of consumption is essential for conservation of resources and their deployment on a sustained basis. Planning appropriate levels of consumption should go hand in hand with investment and production planning. Judicious development expenditures on health, education, nutrition, etc. yield returns vastly more in proportion to the size of such expenditure by improving the productive potential of labour. Hence, a model of development needs to be devised in which both consumption and investment expenditures are so planned as to yield the highest possible social rate of return. In other words, there should be both investment and consumption planning, as instrumentalities for making incomes accrue directly to as great a section of the poor as possible in order to provide a more equitable economic opportunity.

The implications of focusing on consumption planning alongside with investment planning can be spelled out as follows :

- (a) Consumer preferences for luxury items will be given low priority;
- (b) The bottom-up approach to development planning (formulation, implementation and evaluation) will be given relatively more importance than the top-down approach;
- (c) The development plan will be likely be more prescriptive than indicative;
- (d) More emphasis will be laid on breaking up the uni-factor processes of production than currently obtains;
- (e) The development plan will differentiate between the per capita income growth rates of two or more different income groups;
- (f) The pattern of final demand will be influenced by a desire to provide basic amenities to the largest number of people possible;



(g) Development projects will be appraised in terms of social profitability in which employment plays a key role;

(k) Development planning will envisage maximizing per capita national income within the limits set by the predetermined number of people who are expected to cross the threshold of subsistence or crawl towards it, and by the increases in the levels of employment implied by these limits;

(i) Development constraints will be viewed more as schedules in relation to the quantum and types of production as well as to the methods of production employed;

(j) Direct controls may have to play a more important role than at present;

(k) The level of the social rate of time discount may get automatically fixed as soon as the number of people who ought to cross the threshold of subsistence is determined. By the same token, the relative importance of labour-intensive techniques could also be automatically determined;

(1) By the very nature of the "consumption" and "employment" plan, the benefits of development will accrue to those who deserve them most. Hence, public participation in the planning process will be likely to be more readily forthcoming. This will be all the more so as the development effort which underlies the "consumption" and "employment" planning approach will take on the character of area (community) development, the establishment of indigenous industries and rural public works.

#### Notes

1/ Exhaustive use is use for consumption with no increase of production or transformation into other productive commodities, either intended or achieved.

2/ The argument cannot be reversed; it cannot be maintained for instance, that say a 25 per cent sudden reduction in the existing population would not adversely affect the growth or even the existing volume of the world gross product because of the disruption thereby caused to the production process. Otherwise, the situation would remain the same in both cases. The existing population has found for itself a role in the productive process. The individual marginal productivity of labour is positive, however small. But the same thing cannot be said about its social, marginal productivity because of the presence of off setting factors such as the foregone alternative or opportunity increases in the productivity of the other factors of production, e.g., physical capital (due to increasing returns to this factor), with or without technological change. Given the present patterns of production and the associated deployment of technology, the same conditions will prevail, only more starkly as the expected increase in population comes about. The individual marginal productivity of labour will become still smaller, though positive, and its social marginal productivity will remain zero, if not negative.



3/ The size of such number is staggering, and is apt to throw the currently available planning methodologies out of focus. In view of the giant increases of several hundred per cent in population, any guesses that one would like to make about the shape of things in the next years, let alone longer, are likely to be implausible. The identification of emerging problems and assessment of alternative responses have to be done for shorter intervals, with provision made for continual revision in the light of improved data and keener analytical preception. These "rolling" projections cannot always be global either. An average across-space tends to be unrepresentative when the dispersion happens to be several times the average, as witness, for example, a global average GDP of \$ US 2,300 per capita (1975 dollars) in 2000 with per capita GNP in the same year of \$ US 11,000 for Japan and \$ US 200 for India, these being just two observations in the series over which the average is obtained. Apart from being "rolling", the projections will have to be regional or local in scope, again with constant provision made for cross-sectional integrability. The iteration between "time" and "space" is yet another dimension of long-range projections. Making technological choices and organizing "maintenance management" are two examples of such interactive decision-making.

4/ It is naive and wrong to conclude from this that there is no urgency in formulating and implementing demographic and socio-economic initiatives to regulate and eventually to stabilize world population at stationary levels. Actually, the postponement of the date of achieving a net reproduction rate (NRR) of unity can be very costly, and even disastrous. For example, one estimate shows that, if India were to attain NRR of 1.0 in the year 2000, its ultimate stationary population would be 1.4 billion. If its reaching NRR of 1.0 were, however, postponed until the year 2020, the size of its stationary population would be 2 billion.

5/ "Desertification will probably be a major modifier of landscapes between now and 2000. If all the lands identified by the United Nations as having a high or very high probability of desertification were to become desert by 2000, deserts could occupy more than three times the 7,992,000 square kilometres they occupied in 1977. Most of the land lost would be pasture-land, but losses in cropland could also be significant ... most of the losses would probably take place in Africa and Asia. Desertification is an active ongoing phenomenon, and its implications are not a matter of speculation. The economic bases of several West African countries, including Mauritania, Senegal, Upper Volta, Mali, Niger and Chad have recently been undermined through the extensive desert expansion that occurred during the 1968-1973 drought. These countries will find recovery difficult, as the damage done to soils was long-term. Sudan, Somalia, Ethiopia, Kenya and Tanzania have also suffered degradation of soils associated with the recent drought". The Global 2000 Report to the President (New York, Penguin Books Ltd., 1982) p. 277.

6/ A rough idea of the degree of soil erosion in the world may be obtained from estimates of the suspended sediment loads of major rivers. One such estimate based on 16 major rivers of the world is that for a drainage basin of approximately 21 million square kilometre, the suspended load is



7.5 billion metric tons or an average of 363 metric tons per square kilometre of the drainage basin. The averages for the Yellow, Ganges and Brahmaputra rivers are 2,800, 1,500 and 1,100 metric tons of suspended load per square kilometre of drainage basin, respectively. The FAO observes that the most susceptible areas are the lands receiving medium to high rainfall with latitudes approximately 42° north and 42° south. It also observes: "Whilst heavier sediment loads are associated with humid tropical zones, there is also a positive correlation with the relative proximity of mountains to the sea. This is especially so in Southeast Asia ...", Food and Agriculture Organization of the United Nations, The State of Food and Agriculture, 1977, p. 35.

7/ "The Deputy Prime Minister of Peninsular Malaysia shocked his compatriots by projecting that the region's once-lush forests would be severely depleted in just 12 years. He predicted that by 1990 the rate of timber production would not be adequate to meet domestic, let alone foreign, demand. Stringent new logging controls are being imposed in Thailand following the National Forestry Department's estimate that the country's forests are shrinking by 250,000 hectares a year, and that they will be virtually gone in 25 years if present logging and farming practices continue.

Recent satellite pictures of the Philippines, traditionally a major timber exporter, indicate that forests now cover just under 30 per cent of the country, though the Government feels a forest cover of 46 per cent is desirable for economic and environmental reasons. If existing logging patterns prevail, a consortium of Philippines research organization has concluded, all original old-growth forests will have been cut down by the year 2000 and projected timber supplies from second-growth forests and plantations will not suffice to meet even domestic basic needs. Destructive increases in flooding and sedimentation have already been registered.

In Nepal - to provide an extreme case, yet one of importance ... because of the country's ecologically strategic location - the spread of farming and the collection of fuel and fodder have combined to reduce the forested area in the hill zone by 25 per cent over the last decade. In 1976, a Nepalese research group concluded that a continuation of existing trends would result in the complete disappearance of accessible forests in the hills within 15 years - which the researchers themselves labeled a doomsday 'forecast'.

Usually, uncontrolled deforestation is a symptom of a society's inability to get a grip on other fundamental development problems, agricultural stagnation, grossly unequal land tenure, rising unemployment, rapid population growth, and the incapacity to regulate private enterprise to protect the public interest." Erik Eckholm, Planting for the Future: Forestry for Human Needs, Worldwatch Paper 26 (1979), pp. 14-19.

8/ "... World-wide an estimated 125,000 hectares of irrigated land are lost from production each year due to waterlogging, salinization and alkalinization. This loss rate amounts to ... about .06 per cent per year of the world's total irrigated land. If it remains constant through the year 2000, about 2.75 million hectares (approximately 1.4 per cent of the world's total irrigated land) will be out of production." The Global 2000 Report, p. 279.



9/ The Global 2000 Report, p. 279.

10/ Food and Agriculture Organization of the United Nations, The State of Food and Agriculture, 1977, pp. 3-16.

11/ The Cocoyoc Declaration, Ceres, 42, "Energy and natural resources", p 32.

12/ A United Nations study by Wassily Leontief, et al., The Structure of the World Economy (New York, Oxford University Press, 1977) pp. 10-11. Further, the study observes that if target growths were to be maintained in the year 2000, no developing region could afford to have a level of personal consumption above 63 per cent of income and a level of private investment of less than 20 per cent. Moreover, in order to meet food requirements in a standard scenario, agricultural production would have to rise in 2000 by 400 per cent from the present levels with higher rates of increase in specified areas. It was found that in low income Asia and in low income Latin America, agricultural output would have to increase by over 500 per cent, and in the Middle East by 950 per cent.

13/ "As the size of cities increases, so do noise, air and water pollution; and competition for goods, services and space intensifies. Thus competition for space is evident in a comparison of various housing conditions in India, where the proportion of families living in dwelling of one room is 34 per cent in rural areas as 44 per cent in urban areas, 67 per cent in the four largest cities and 70 per cent in Calcutta ..." Lester R. Brown et al., Twenty-Two Dimensions of the Population Problem, Worldwatch Paper 5 (March 1976) p. 51.

14/ The Global 2000 Report, p. 246.

15/ Updated income projections cast reasonable doubt on the feasibility of obtaining these rates because of a more halting growth trend of the Organisation for Economic Co-operation and Development (OECD) countries and the impact of this slower growth on the rest of the world.

16/ The Global 2000 Report, part I, "The projections", p. 4.

17/ Development and Environment (Founex, Switzerland, 1971), pp. 6-8.

18/ "The trend in marine fish has been downward since the peak year of 1970, demonstrating that the traditional marine fish populations are now fully exploited. In fact, many are severely over-exploited. The catch of crustaceans has been nearly constant since 1970 at about 2.0 mmt. Mollusks have increased, but in only small amounts. It seems unlikely, therefore, that the generally accepted annual potential of 100 mmt of traditional marine species will be achieved on a sustained basis. It is more likely that the potential is nearer the present catch, or about 60 mmt". The Global 2000 Report, part I, "The projections", p. 105.

19/ World Bank, World Development Report 1982, p. 60.



20/ Lester R. Brown et al., op. cit. pp. 38-39.

21/ The share of oil in the total commercial energy production of the world is about 50 per cent. This figure, however, understates the role of oil in the world economy for two reasons. First, oil-using sectors such as transport usually influence to a considerable extent, if not actually determine, the level of activity in the rest of the economy; second, other forms of energy cannot be substituted for oil without substantial investment of primary factors of production such as labour and capital. One well-known fact is that oil on the average is 2.25 times as efficient in use as coal. What is more, its actual relative efficiency is higher in terms of useful energy. Thus, oil acquires the character of a crucial input, almost non-substitutable in the short run.

22/ The Global 2000 Report, "The study in brief", p. 29.

23/ "There remains the physicist's greatest dream, controlled thermonuclear deuterium-reaction. To constitute a real breakthrough, it must be the deuterium reaction, the only one that could open up a formidable source of terrestrial energy for a long era. But, the conditions for its success are well-nigh impossible to fulfil. The fusion of deuterium requires the fantastic temperature of 0.2 billion<sup>o</sup>F, one order of magnitude hotter than the Sun's interior." Georgescu-Roegen, Energy and Economic Myths, (Oxford, Pergamon, 1976), p. 29.

24/ D. V. Raman, An Overview of Environment and Development: Asia and the Pacific, (Bangkok, Asian and Pacific Development Institute, 1980), p. 150.

25/ William D. Nordhaus, "Resources as a constraint on growth", The American Economic Review, vol. LXIV, No. 2 (May 1974), pp. 22-25.

26/ Robert M. Solow, Richard T. Ely Lecture, "The economics of resources or the resources of economics", The American Economic Review, vol. LXIV, No. 2 (May 1974), p. 11.

27/ Lester R. Brown, The Twenty Ninth Day (New York, W. W. Norton & Co., Inc., 1978), pp. 178-179.

28/ Cf. World Bank, Energy in the Developing Countries, (August 1980).

29/ Barry Commoner, "The solar transition: compatible conventional energy systems", Conference on Long Term Energy Resources (UNITAR/CF7/I.2), vol. 1 (1979).

30/ Cf. Brown, Twenty Ninth Day, op. cit., p. 165.

31/ David Pimental et al. "Food production and the energy crisis", Science (2 November 1973), p. 445.

32/ Leontief, et. al., op. cit., p. 6.



33/ World Bank, World Development Report 1978, pp. 33-34.

34/ Lester R. Brown, World Population Trends: Signs of Hope, Signs of Stress, Worldwatch Paper 8 (October 1976), p. 18.

35/ Cf. World Bank study of the substitution of labour and equipment in civil construction, Technical memorandum No. 26.

36/ Alain Birou, Paul-Marc Henry and John P. Schlegel (eds.), Towards a Redefinition of Development (Organisation for Economic Co-operation and Development, 1977), p. 299.

37/ Resource management should become an accepted element of development planning. Starting with a proper planned development, investment for production should provide for proper conservation in the case of non-renewable scarce resources and an adequate provision for replacement (forests, for example) in the case of renewable scarce resources. Resource replenishment provision is akin to the national income accounting practice of depreciation provision and should become an equally accepted practice. Since an effective availability of resources should imply their availability at the place of demand (place utility), far more attention should be given to spatial (area) planning and timely and adequate delivery (supply) of resources at the local level. The use of local resources to the maximum extent possible should become a development ethic.

38/ Denis Hayes, Repairs, Reuse, Recycling: First Steps Towards a Sustainable Society, Worldwatch Paper 23 (1978), p. 17.



Table 1. Population and per capita gross national product and per capita "resource consumption" in 20 most populous countries

Country	(1) Population (millions) 1975	(2) GNP, \$ US 1974 per capita	(3) As a multiple of GNP per capita of Bangladesh	(4) Per capita consumption of grain, kg 1975	(5) As a multiple of con- sumption of grain by Nigeria	(6) Per capita consumption of energy kg. coal equivalent	(7) As a multiple of consump- tion of energy by Bangladesh	(8) Per capita consumption of steel, kg. 1971	(9) As a multiple of con- sumption of steel by Indon- esia
1. United States	214	6,640	66	708	8	11,485	370	617	123
2. Federal Rep. of Germany	61	5,890	59	441	5	5,689	184	580	116
3. France	52	5,190	52	446	5	4,330	140	414	83
4. Japan	112	3,880	39	274	3	3,839	124	551	110
5. United Kingdom	54	3,360	34	294	4	5,464	176	361	72
6. Italy	55	2,770	28	413	4	3,227	104	339	68
7. USSR	254	2,300	23	645	7	5,252	169	471	94
8. Spain	35	1,960	20	508	6	2,063	67	...	...
9. Mexico	60	1,000	10	304	3	1,269	41	78	16
10. Brazil	109	900	9	239	3	646	21	77	15
11. Turkey	42	690	7	415	5	628	20	...	...
12. Philippines	43	310	3	157	2	309	10	21	4
13. People's Rep. of China	935	300	3	218	2	632	20	31	6
14. Thailand	42	300	3	225	2	300	10	...	...
15. Egypt	37	280	3	286	3	322	10	...	...
16. Nigeria	63	240	2	92	1	94	3	10	2
17. Indonesia	135	150	2	152	2	158	5	5	1
18. India	618	130	1	150	2	201	6	14g/	3
19. Pakistan	71	130	1	171	2	188	6	6	1
20. Bangladesh	79	100	1	203	2	31	1	...	...

Source: Lester R. Brown, The Twenty-Ninth Day (New York, Norton, 1978), pp. 196, 200 and 202;  
In the Human Interest (Oxford, Pergamon, 1974), p. 34.

g/ Including Bangladesh.



Table 2. World Production per capita of key commodities of biological origin, 1960-1978, with peak years underlined

Year	Forests	Fisheries	Grasslands		Croplands	
	Wood (m <sup>3</sup> )	Fish (kg)	Beef (kg)	Mutton (kg)	Wool (kg)	Cereals (kg)
1960	--	13.4	9.43	1.91	<u>0.86</u>	287
1961	0.65	14.3	9.67	1.91	0.85	278
1962	0.66	14.5	9.90	1.90	0.85	292
1963	0.66	14.7	10.25	1.89	0.83	286
1964	0.67	16.1	10.12	1.84	0.81	297
1965	0.67	16.2	10.09	1.82	0.79	290
1966	0.67	17.1	10.39	1.80	0.80	308
1967	<u>0.67</u>	17.7	10.59	1.92	0.79	308
1968	0.66	18.4	10.86	1.92	0.80	318
1969	0.66	17.7	10.90	1.88	0.79	316
1970	0.66	<u>19.5</u>	10.80	1.90	0.76	314
1971	0.66	19.2	10.57	1.91	0.74	335
1972	0.65	17.6	10.75	<u>1.92</u>	0.73	319
1973	0.66	17.5	10.63	1.83	0.67	337
1974	0.65	18.1	11.16	1.80	0.65	322
1975	0.62	17.6	11.49	1.80	0.67	321
1976	0.62	18.2	<u>11.81</u>	1.79	0.65	<u>342</u>
1977	0.62	17.4	11.53	1.78	0.63	333
1978	0.61	16.6	11.21	1.77	0.64	340

Source: Lester R. Brown, Resource Trends and Population Policy : A Time for Reassessment, Worldwatch Paper 29, (May 1979), p. 9.



Table 3. Non-commercial energy use and energy intensity of GDP in some Asian Countries (around 1976)

Country of area	Proportion of non-commercial energy use in total energy use	Energy intensity of one \$ GDP in million joules
Afghanistan	0.84	85
Bangladesh	0.91	109
Brunei	0.09	...
Burma	0.84	90
China	0.16	59
Dem. Kampuchea	...	...
Hong Kong	...	19
India	0.58	103
Indonesia	0.54	...
Iran (Islamic Rep.of)	0.12	27
Japan	...	25
Lao People's Democratic Republic	0.88	189
Malaysia	0.19	29
Mongolia	0.68	121
Nepal	0.98	194
Pakistan	0.66	103
Philippines	0.39	44
Rep. of Korea	0.06	59
Singapore	...	26
Sri Lanka	0.59	47
Thailand	0.47	49
Viet Nam	0.53	...

Source: Arjun Makhijani, "Economics and sociology of alternative energy sources", paper presented to the Regional Seminar on Alternative Patterns to Development and Life-styles in Asia and the Pacific, unpublished (August 1979). World Bank Atlas (1977), p. 28.



Table 4. World oil production, total and per capita, 1950-2000

Year	Population (billions)	Oil production (billion barrels)	Oil production per person (barrels)
1950	2.50	3.8	1.52
1951	2.54	4.3	1.69
1952	2.59	4.5	1.74
1953	2.63	4.8	1.83
1954	2.68	5.0	1.87
1955	2.72	5.6	2.06
1956	2.77	6.1	2.20
1957	2.82	6.4	2.27
1958	2.88	6.6	2.29
1959	2.93	7.1	2.42
1960	2.99	7.7	2.58
1961	3.04	8.2	2.70
1962	3.10	8.9	2.87
1963	3.16	9.5	3.01
1964	3.22	10.3	3.20
1965	3.29	11.1	3.37
1966	3.35	12.0	3.58
1967	3.41	12.9	3.78
1968	3.48	14.1	4.05
1969	3.54	15.2	4.29
1970	3.61	16.7	4.63
1971	3.68	17.7	4.81
1972	3.75	18.6	4.96
1973	3.82	20.4	5.34
1974	3.89	20.5	5.27
1975	3.97	19.5	4.91
1976	4.04	21.2	5.25
1977	4.12	21.8	5.29
1978	4.21	22.0	5.23
1980	4.37	22.3	5.10
1985	4.82	23.4	4.85
1990	5.28	24.6	4.66
1995	5.76	23.4	4.06
2000	6.25	22.2	3.55

Source : Lester R. Brown, Resource Trends and Population Policy : A Time For Reassessment, Worldwatch paper 29, (May 1979) pp. 18 and 23.



Table 5. Annual per capita grain and cropland requirements  
for food and automotive fuel

Purpose	Grain (pounds)	Cropland <u>a/</u> (acres)
Subsistence diet	400	0.2
Affluent diet	1,600	0.9
Typical European automobile (700 miles/year at 25 mi. per gal.) <u>b/</u>	6,200	3.3
Typical United States automobile (10,000 miles/year at 15 mi. per gal.) <u>b/</u>	14,600	7.8

Source: Lester R. Brown, Food or Fuel : New Competition for the World's Cropland, Worldwatch Paper 35 (March 1980) p. 27.

a/ Based on average world grain yields in 1978, according to the United States Department of Agriculture.

b/ Fuel use converted at 380 litres of alcohol per metric ton of grain.



Table 6. Agricultural population in relation to crop area

Country	Crop area 1975 (100,000 ha.)	Agricultural population per 100 ha. of crop area 1975	Projected agricultural population in 1990 per 100 ha. of crop area in 1975	Percentage change of (4) over (3)
(1)	(2)	(3)	(4)	(5)
Bangladesh	720	660	980	+48
Burundi	126	256	380	+48
Dominican Rep.	100	302	430	+42
Egypt	286	687	890	+30
India	16,720	244	310	+27
Indonesia	1,860	458	540	+18
Pakistan	1,945	204	280	+37
Japan	557	289	130	-55
Netherlands	84	107	60	-44
Rep.of Korea	242	641	520	-19

Source: World Bank, World Development Report 1980, p. 39.







## B. The effects of population growth on renewable resources

Roger Revelle\*

As human beings have increased in numbers and in technological capability, their impacts on their own environment have become more pronounced. Indeed, one definition of the process of civilization might be that it consists of the increase in control of the environment by human beings. Most of these environmental controls, however, are local - small on a global scale - and involve those parts of the environment such as houses and cities which immediately surround human beings or which directly serve their interest, as for example, agricultural lands, rivers and in-shore ocean waters, and land areas containing valuable fuels of minerals.

Large-scale global effects have become evident in recent years for several reasons: the scale of human activities has widened; there is a growing recognition that human lives depend on the finite resources of a small planet; and we are not able to measure subtle changes that could not be detected until sophisticated instruments were developed.

An obvious example is the growing concentration of carbon dioxide. The year-by-year increase in this odourless, tasteless, invisible gas is now being carefully monitored on a worldwide basis with highly accurate measurement methods. Forty years ago, before these methods were developed, scientists suspected that atmospheric carbon dioxide was increasing, but they had no means of demonstrating this increase because of the coarseness of their measurements.

We are almost certain that the increase in carbon dioxide will continue and accelerate, largely because of the increasing use of fossil fuels, and we suspect that this will ultimately have profound effects on world climates. But, again because of the inadequacy of our methods of measurement, we have no unequivocal evidence of a carbon-dioxide-induced climatic change, even though the amount of carbon dioxide in the air has risen by at least 16 per cent over the last 100 years.

Many other human effects on the resource base have been described or suggested in recent years: desertification - the creeping inroads of deserts and wastelands on farms and grazing lands; soil erosion by wind and water; salinization and waterlogging of irrigated lands; the deleterious effects of acid rain on lakes, forests and orchards; the potential effects of fluorohydrocarbons on the ozone concentration of the stratosphere; increasing atmospheric concentrations of methane and nitrogen oxide (which add to the "greenhouse effect" of carbon dioxide); air and water pollution related to the growth of cities and increasing levels of energy use; and, as farmlands are brought under irrigation, the spread of water-borne diseases such as schistosomiasis. The evidence for most of these effects is anecdotal and impressionistic, for the most part, convincing statistical data on a global scale do not exist. Moreover, the relationships, if any, with human population growth are not easily demonstrated. In many cases, the effects of population growth appear to be less important than those resulting from rapid technological change.

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\* University of California, San Diego, La Jolla, California



One of the few clear-cut examples of the environmental effect of population growth is the increase of the area of agricultural lands during the last 120 years when the world's human population grew by more than threefold. Throughout most of this period, food yields per unit area of cultivated land changed very slowly, and growing human populations could be fed only by bringing more land under the plow. Here we do not need to consider the direction of cause and effect, i.e., whether human population growth resulted from growth in agricultural land area or whether the increase in agricultural land resulted from growth, brought about by other causes, in the number of human mouths to feed.

J. H. Richards of Duke University has studied historical records of changing land-use patterns and vegetation cover for all countries over the past 100 to 200 years. In particular he has estimated the areas of land cleared and converted to agriculture since 1860. Working in collaboration with Ralph Rotty of the Institute for Energy Analysis in Oak Ridge, Tennessee, and Jerry Olson of Oak Ridge National Laboratory, the areas of the original natural ecosystems which were cleared and converted were estimated. Some of the results are shown in table 1 in which the area of farmland in 1860 is given for each major subdivision of the earth's land surface (totalling 13 billion hectares or 130 million square kilometres) where significant populations of human beings now live. The increase in arable land between 1860 and 1920 and between 1920 and 1978 is also shown and, finally, the areas of "arable land and land under permanent crops" in 1978. (See FAO Production Yearbook, 1979 (Rome, 1980) for a definition of terms.) It will be seen that during these 120 years, the area of the earth's farmland increased by about 850 million hectares to between two and three times the farmed area in 1860. As may be seen from table 2, the world's human population increased by about three-and-one-half times during this period.

Between 1860 and 1920, more than half of the increase in farmland occurred in the developed areas, that is, Canada and the United States of America, Europe, the Union of Soviet Socialist Republics, and Oceania (Australia and New Zealand), and these regions also produced more than half of the world-wide growth in population. Population growth speeded up dramatically between 1920 and 1978, being between four and five times that in the previous 60 years. Eighty per cent of this population increase took place in the currently developing regions - Africa, Asia, Latin America, and the Caribbean. Correspondingly, nearly 80 per cent of the growth in the world's cultivated area took place in these regions and only 23 per cent occurred in the developed ones.

As shown in table 3, the areas of farmland per person in the developed regions in 1860 were on the average about three times those in the developing regions. This ratio between developed and developing regions remained about constant throughout the following 118 years, although the amount of farmland per person decreased significantly over this period in both developed and developing regions.

At least in part, because of differences in population densities, there were marked differences in the areas of farmland per person between regions. In the developed areas, for example, the cultivated area per caput in 1978 was



Table 1. Land cleared for agriculture, 1860-1978  
(Millions of hectares)

	(1) Arable area in 1860	(2) Increase in 1860-1920	(3) Arable area 1920-1978	(4) Arable area in 1978
<b>Developed regions</b>				
Canada and USA	76	161	-2	235
Europe	120	21	2	143
Oceania	4	11	29	44
USSR	<u>81</u>	<u>88</u>	<u>63</u>	<u>232</u>
	281	281	92	654
<b>Developing regions</b>				
Africa	63	16	91	170
Asia	211	91	147	449
Latin America	<u>17</u>	<u>40</u>	<u>84</u>	<u>141</u>
	291	147	322	760
<b>World total</b>	572	428	414	1414

**Sources:** For column (1), column (4) minus column (2) and (3); for column (2) and (3), J. F. Richards, Jerry S. Olson and Ralph Rotty "Development of a data base for carbon dioxide release resulting from conversion of land to agricultural uses", Institute for Energy Analysis, Oak Ridge, Tennessee; for column (4), FAO Production Yearbook, 1979 (Rome, 1980).



Table 2. Estimated world population, 1860-1978  
(Millions)

	(1)	(2)	(3)	(4)	(5)	(6)
	1860	1920	1970	1978	Increase 1860-1920	1920-1978
<u>Developed regions</u>						
Canada and USA	35	115	226	242	80	127
Europe	209	340	459	480	131	140
Oceania	2	9	19	22	7	13
USSR	<u>74</u>	<u>145</u>	<u>243</u>	<u>261</u>	<u>71</u>	<u>116</u>
	320	609	947	1005	289	396
<u>Developing regions</u>						
Africa	100	136	354	443	36	307
Asia	820	997	2091	2461	177	1464
Latin America	<u>37</u>	<u>92</u>	<u>283</u>	<u>349</u>	<u>55</u>	<u>257</u>
	957	1225	2728	3253	268	2028
<u>World total</u>	1277	1834	3675	4258	557	2424

Sources: For column (1), R. Revelle and W. H. Munk in Energy and Climate, 1977; for column (2), Philip Hauser in Rapid Population Growth, 1971; for columns (3) and (4), United Nations Demographic Yearbook, 1980 (United Nations publication, Sales No. E/F.81.XIII.1); for columns (5) and (6), computed from columns (1), (2) and (4).



Table 3. Arable land per person and "population elasticity" of arable land

	Arable land per person (ha.)				"Population elasticity" Arable / Population	
	1860	1920	1970	1978	1860-1920	1920-1978
<u>Developed regions</u>						
Canada and USA	2.17	2.06	1.01	0.97	2.01	-0.02
Europe	0.57	0.41	0.31	0.30	0.16	0.01
Oceania	2.00	1.67	2.21	2.00	1.57	2.23
USSR	<u>1.09</u>	<u>1.17</u>	<u>0.95</u>	<u>0.89</u>	<u>1.24</u>	<u>0.54</u>
	<u>0.88</u>	<u>0.92</u>	<u>0.68</u>	<u>0.65</u>		
<u>Developing regions</u>						
Africa	0.63	0.58	0.45	0.38	0.44	0.30
Asia	0.26	0.30	0.21	0.18	0.51	0.10
Latin America Caribbean	0.46	0.62	0.46	0.40	0.72	0.33
	<u>1.30</u>	<u>0.36</u>	<u>0.27</u>	<u>0.23</u>		
<u>World averages</u>	0.45	0.55	0.37	0.33	0.77	0.17

Source: Tables 1 and 2.



about 2 hectares in Oceania and only 0.3 hectares in Europe. In the developing regions in 1978, there were 0.4 hectares/person in the Latin American-Caribbean region and about the same in Africa, but less than 0.2 hectares in Asia. There were also large differences between individual countries within most regions; these were related to differences in both climate and living standards. For example, in Brazil, farmland area per person was only .34 hectares in 1978, whereas in Argentina it was 1.33 hectares.

On a world-wide basis, and to a large extent within regions, the decrease in farm area per person as time passed reflected in part increases in crop yields per hectare resulting from advances in agricultural science and technology, and in part increases in irrigated areas which allowed the intensity of cultivation (the number of crops grown/hectare/year) to increase as well as allowing growth in crop yields.

The effects of increases in crop yields and in multiple cropping permitted by irrigation are best seen by considering the population elasticity of agricultural land areas, that is, the increase in farmland area in each period divided by the increase in population during that period. Between 1860 and 1920, the world average increase in arable land area divided by the increase in population was 0.77 hectares/person; between 1920 and 1978 it was only 0.17 hectares/person. There was a marked difference between regions in both periods. Between 1860 and 1920 the population elasticity of farmland was 2.01 hectares per person in the United States and Canada and only 0.16 in Europe. Between 1920 and 1978, this quantity for the United States and Canada was actually negative, and in Europe it was only 0.01 hectares/person, whereas in Oceania it was 2.23.

During the last 10 years, the rate of increase of arable land for each additional person has markedly diminished, being only 0.06 hectares per person on a world-wide basis. In Asia, the increase is even smaller, 0.02 additional hectares/person, and in Europe, it is negative - 0.15 hectares/person.

The recent diminution in the rate of increase of arable land is emphasized when we consider average annual increases between 1860 and 1978. During the first 60 years, an average of 7.1 million hectares were cleared for agriculture each year. This corresponded to an area 270 kilometres on a side - the size of Ireland. The average rate of clearing increased somewhat after 1920 to an average of about 7.6 million hectares between 1920 and 1970. Between 1970 and 1978, however, only 4.5 million hectares were cleared each year (Food and Agriculture Organization of the United Nations, 1980).

From the data given by Richards, Olson and Rotty, it is possible to compute the areas of different natural ecosystems cleared for agriculture between 1860 and 1978. These numbers are shown in table 4, with the natural ecosystems combined into six categories: forests, woodlands, savannas, grasslands, wetlands (swamps and marshes) and deserts. For the world as a whole during these 118 years, 302 million hectares of grassland were converted to agriculture and 254 million hectares of forest were cleared and converted. Woodland clearing and conversion amounted to 161 million hectares. Savanna lands converted to agriculture, mostly in Africa and Asia, made up 117 million



Table 4. Areas of different ecosystems cleared for agriculture, 1860-1978  
(Millions of hectares)

	(1) Forests	(2) Woodlands	(3) Savannas	(4) Grasslands	(5) Swamps	(6) Deserts	(7) Total
<u>Developed regions</u>							
Canada and USA	51.0	13.0	10.7	84.9	-	-	159.6
Europe	10.6	0.3	1.8	8.4	3.4	-	24.5
Oceania	23.1	12.3	13.3	5.1	-	0.5	54.3 <sup>a/</sup>
USSR	43.7	13.6	1.7	88.4	-	3.2	150.7
	128.4	39.2	27.5	186.8	3.4	3.7	389.0
<u>Developing regions</u>							
Africa	18.4	28.9	23.9	32.5	-	3.1	106.8
Asia	62.9	62.8	50.0	37.4	17.7	7.3	238.1
Latin America	39.6	25.3	16.1	40.1	0.1	3.1	124.5
	120.9	117.0	90.0	110.0	17.8	13.5	469.4
<u>World total</u>	249.3	156.2	117.5	296.8	21.2	17.2	858.4 <sup>a/</sup>

Source: J. F. Richerds, Jerry S. Olson and Ralph Rotty, "Development of a data base for carbon dioxide release resulting from conversion of land to agricultural uses", Institute for Energy Analysis, Oak Ridge, Tennessee.

<sup>a/</sup> Including 14.3 million hectares converted to cultivated pasture not accounted for in table 1; hence total of converted hectares in this table is higher than in table 1.



hectares. In addition, 21 million hectares of swamps and marshes were drained for agriculture, and 17 million hectares of desert lands were brought under irrigation.

The breakdown by continents in the different ecosystem categories is also shown in table 4, from which it may be seen that in Canada and the United States of America and the USSR, more than half the land converted to agriculture was originally grassland and about a third was in forests, with most of the remainder being woodlands. In Asia, Central and South America, and Oceania, more than half the converted land was originally in forests and woodlands. In Africa, ecosystems converted to agricultural land were more or less evenly divided between forests and woodlands, on the one hand, and savannas and grasslands, on the other, and this was also true of Europe. About 85 per cent of wetlands (swamps and marshes) drained for agriculture - probably mostly for paddy rice cultivation - were in Asia. Over 40 per cent of desert lands brought under irrigation were also in Asia.

On a world-wide basis (see table 5), 7.6 per cent of the total forest lands existing in 1860 had been converted to agriculture by 1978. Woodland, savanna and grassland conversion amounted, respectively, to 7.9 per cent, 6.1 per cent and 10.0 per cent of the areas in these categories in 1860. About the same percentages of the areas of swamps and marshes in 1860 were drained for agriculture during the subsequent 118 years, but less than 1 per cent of desert lands were brought under cultivation.

The clearing of land for agriculture and other transformations of pre-existing ecosystems by human activities has resulted in a significant transfer of carbon from the organic matter in plants and soils to carbon dioxide in the atmosphere. Richards, Olson and Rotty (table 4) estimate that carbon released from the terrestrial biota as a consequence of land conversion to agriculture amounted to 21.4 Gtons (one Gton = 1 billion tons) of carbon between 1860 and 1920 and to 18.3 Gtons between 1920 and 1978. Carbon released from the soils of converted lands amounted to nearly 6 Gtons between 1860 and 1920 and to slightly over 12 Gtons between 1920 and 1978. The total carbon released from land use conversion was thus 27.4 Gtons between 1860 and 1920 and 30.3 Gtons between 1920 and 1978. The sum of 57.7 Gtons from 1860 to 1978 was about half the amount of carbon dioxide released by combustion of fossil fuels. Indeed, carbon dioxide released from the biosphere by human activity during the earlier period between 1860 and 1920 was probably in excess of that released by fossil fuel combustion, which Rotty has estimated at about 25 Gtons.

Richards (personal communication) believes that an amount of carbon approximately equal to that released by conversion of natural ecosystems to agriculture was released by other human actions that did not involve an increase in agricultural land area. These include:

(a) Cutting and burning of forest and brush for railway right-of-way and fuel purposes - a world-wide process begun in 1860;



Table 5. Percentage of areas of different ecosystem cleared for agriculture, 1860-1978

	(1) Original area (millions of ha)	(2) Cleared for Agriculture	(3) Percentage Cleared
Forests	3284	249	7.6
Woodlands	1975	156	7.9
Savannas	1936	118	6.1
Grasslands	2988	297	10.0
Swamps	271	21	7.7
Deserts	1843	17	0.9

Sources: For column (1), J. S. Olson, et al., "Carbon in land vegetation", Carbon Dioxide Review (1982), pp. 436-437; for column (2), table 4.



(b) Increased cutting and burning of forests as a result of the pressure put upon shifting cultivators world-wide - the length of forest fallow was markedly reduced in every part of the world during this period;

(c) Cutting and burning of domestic and industrial fuel wood to meet the needs of rapidly growing populations;

(d) Commercial timbering operations which reached many hitherto untouched regions and in which the area was allowed to regrow or used for non-agricultural purposes;

(e) Intensified use of grasslands, brushlands and woodlands by pastoralists under pressure from the expansion of settled agriculture;

(f) Clearing of forests and woodlands for use as grazing land (particularly important in Latin America and Oceania).

All these processes have resulted in the degrading of the initial ecosystems in the sense that the mass of carbon in the living biota and in the "humus" of the underlying soil was diminished. Most processes involved the degradation of forests or transitions from forests to woodlands, savannas or grasslands. Assuming that the calculated carbon release all came from forests, and that the average difference in carbon mass between forests and these transition ecosystems was about 100 tons per hectare, the original forested area in 1860 would have been 3,830 million hectares as against the 1978 area of 3,030 million hectares. In other words, the area of the "quality" of forests was reduced by about 21 per cent during these 118 years - an average of 6.8 million hectares per year.

The rate of forest degradation has probably slowed in recent years. For example, between 1963 and 1978, according to the FAO Production Yearbook (FAO, 1980), the total area of forests and woodlands was reduced by 82 million hectares. Using the ratio of original forest-to-woodland areas calculated from table 5, the average annual rate of forest destruction or degradation was 3.4 million hectares per year between 1963 and 1978. This is probably a minimum figure because it does not take into account the conversion of forests to woodlands. (The FAO Production Yearbook does not distinguish between forest and woodlands.)

Desertification - the transition of productive lands to those that are of little or no use to human beings because their fertility or their vegetative cover has been largely destroyed - is an extreme example of land degradation. This process affects primarily arid and semi-arid regions, including savannas, steppes and areas of tropical deciduous forests and Mediterranean climate. The United Nations has estimated the total areas which have been affected to at least some degree by desertification. Their figures, given in table 6 are probably not reliable for rangelands because the numbers are so large that they exceed the total area of "permanent pasture", given by the FAO Production Yearbook. Possibly more reliance can be placed on the estimate of the areas of irrigated land and rain-fed cropland affected by desertification. The table shows that about 21 per cent of irrigated lands in arid regions are so affected, mainly in Asia and the USSR, and about 77 per cent of rain-fed croplands. The arid, rain-fed areas of Asia, South America and Africa are particularly vulnerable to this process.



Table 6. Arid lands affected by desertification  
(Thousands of hectares)

Continent	Irrigated land		Rain-fed cropland		Rangeland	
	Total	Area affected by desertification	Total	Area affected by desertification	Total	Area affected by desertification
Africa	7,756	1,366	48,048	39,633	1,182,212	1,026,758
Asia & USSR	89,587	20,572	112,590	91,235	1,273,759	1,033,963
Australia	1,600	160	2,000	1,500	550,000	330,000
Europe (Spain)	2,400	890	5,000	4,200	16,000	15,500
North America	19,550	2,835	42,500	24,700	345,000	291,000
South America	5,389	1,229	14,290	11,859	384,100	319,380
	126,282	27,052	224,428	173,127	3,751,071	3,071,603

Source: Study on financing the United Nations Plan of Action to Combat Desertification; report of the Secretary-General (A/35/396), 17 September 1980, annex, table 1, pp. 87-89.



Erosion and degradation of precious topsoil is a serious problem in the United States and a devastating one in the tropical areas.

Studies by the Soil Conservation Service of the United States Department of Agriculture show that more than a third of the United States croplands are losing topsoil at a faster rate than it is being formed by natural processes. Wind and water erosion have been accelerated as farmers have followed government advice to plant "from fencepost to fencepost", cutting down the protective windbreaks of trees planted in the 1930's, abandoning terracing, contour-farming and crop rotations that protect the soil in favour of continuous planting of corn and other row crops. In many prime agricultural states, topsoil is being lost at rates of two to three centimeters in less than 20 years. With an average topsoil depth of 20 centimeters, half will have disappeared during the next 100 years. Under present technology, this would result in a 15 per cent or greater drop in yields.

The Soil Conservation Service estimates that programmes to reduce erosion to tolerable limits would cost roughly \$2 billion per year for the next 50 years. Unfortunately, as several studies have shown, most recommended erosion-control measures would run counter to the immediate economic interests of farmers. Government, as the agent of society's long-term interests, must assume a major part of the costs. However, one very effective erosion-control method has recently been introduced, which may be economical from the farmer's point of view. This is "no-till" agriculture, in which the stubble from a harvested crop is left as a protective mulch on the field, chemical herbicides rather than plowing and cultivation are used to control weeds, and planting is done with special equipment which pierces through the mulch into the underlying soil.

Because topsoils are thinner and more fragile in the tropics than in temperature latitudes and rainfall is more violently intense, erosion and other soil-degradation processes are a much greater hazard in many developing countries than in the United States. A United Nations survey has delineated the areas of soil in Northern Africa and the Middle East that are subject to different types of degradational risks. In Nigeria, as one example, about 12 per cent of arable land would, if it were cleared of protective vegetation, be likely to suffer water erosion of more than 200 tons of soil per hectare per year, equal to an annual loss of a layer of soil 1.3 centimetres thick. Roughly 60 per cent of the land is liable to suffer moderate erosion of 10 to 50 tons per hectare per year, equivalent on the average to the disappearance of 1 centimetre of soil in 10 years. Traditional African farming practices, using hoe cultivation of several crops in the same field, with minimum removal of plant cover, may well be an adaptation to these severe erosion threats.

What about the future? If we extrapolate the increase of arable land area up to the year 2025 on the basis of the "population elasticity of 0.06 hectares per additional person during the past 10 years, and adopt the United Nations median estimates of world population in the years 2000 and 2025, the world increase in arable land area should be only a little more than 100 million hectares in 2000 (for an estimated world population of 6,120 million people) and about 225 million hectares in the year 2025 (for an estimated world population of 8,200 million people). The calculated increase in



developing regions would be somewhat greater than the world total; in other words, some land would be expected to go out of production in the developed regions. Arable land in Africa would be expected to increase by 86 per cent for the 45 years between 1980 and 2025 and in South America by about 52 per cent. In Asia, almost all the potential arable land outside the humid tropics is already cultivated, and hence the slight population elasticity of 0.02 newly cultivated hectares per additional person should diminish to zero or even become negative during the next few decades. By the year 2025, the cultivated land area in the currently developing regions should be nearly 1,000 million hectares, and 660 million hectares in the currently developed regions, giving a world cultivated area of 1,650 million hectares.

Present world food production is estimated by FAO as the equivalent of 2,600 (kilocalories)/person/day, of which about 2,155 kcal is consumed directly as vegetable products and 445 kcal comes from meat, milk and milk products, eggs, fish and shellfish. Only about 5 per cent of this total is contained in fish and shellfish used for human consumption; hence the total food energy in animal products produced on cultivated lands and rangelands is 420 kilocalories/person/day. Since the average efficiency of energy conversion of livestock and poultry, including milk cows, is 10.8 per cent, the corresponding number of plant calories is 3,890 kcal/person/day, or a total for both plant and animal foods of 6,040 kcal per caput per day. For the present world population of about 4,500 million people, the weight of plant products in terms of grain equivalent is 2,830 million tons (assuming an energy content of 3.5 million kcal per ton of grain). Thus, today's average plant food production/hectare of cultivated land is close to two tons.

At present, a significant fraction of the world population is malnourished. This would not need to be so if food supplies were more equitably distributed among the earth's people. At present, however, poverty-stricken people in all countries do not obtain enough food to provide a healthful and adequate diet. Thus we may hope that world food production in the future will increase more rapidly than population, perhaps to an average of 7,000 kcal/person/day, or 730 kilogrammes of cereal grain equivalent/person/year. With the projected world population in the year 2025 of 8,200 million people, this would require world primary plant production of about 6,000 million tons or 3.6 tons of grain equivalent per cultivated hectare. We may subtract an unknown, probably small, quantity from this total - perhaps 300 millions tons - for production from uncultivated rangelands, giving a production from cultivated lands of about 3.4 tons of cereal grain equivalent per hectare, a 70 per cent increase over the present quantity per net cultivated hectare, or about 1.2 per cent/year for the next 45 years.

How likely is such an increase in the productivity of cultivated land? At present, world food production is increasing by about 2.5 per cent per year, whereas the area of cultivated land is growing by only 0.3 per cent. Hence, if the present rate of growth of productivity per hectare can be continued or even accelerated, our goal of 7,000 kcal/person/day should be easily attainable within the next 40 years.

Part of the present increase has resulted from the expansion of the area of irrigated land, which grew by over 50 million hectares in the 15 years



between 1963 and 1978. In most of the developing countries, irrigation allows an increase in cropping intensity by about 50 per cent, that is, on an average, 1.5 crops can be grown on each hectare of irrigated land. In effect, by expanding irrigation, the world has added about 25 million hectares of cultivated land in addition to the expansion of cultivated area. When combined with other inputs, yields from irrigated land are one to more than two tons/hectare for each crop. If the irrigated area in the developing regions continue to increase at the same rate over the next 45 years as it did between 1963 and 1978, the total additional irrigated area in 2025 could be 150 million hectares, and plant production from the added irrigated area could be at least 4.5 tons per hectare or 675 million tons, about 20 per cent of the required increase in production.

Other factors responsible for the recent growth in yields are better control of pests and plant diseases, increased use of nitrogen, phosphorous and potash fertilizers, and the use of newly developed, high-yielding plant varieties that are not only responsive to higher applications of fertilizer, but also exhibit somewhat greater photosynthetic efficiency. Present world production of nitrogen fertilizer is about 40 million tons/year, and the corresponding increases in crop production are at least 400 million tons. A tripling of fertilizer use over the next 45 years is the minimum that can be expected, with a resulting increase in plant production of at least 800 million tons. Better control of pests and diseases, primarily by the development and wider use of resistant crop varieties, should allow for an additional several hundred million tons of production. The remaining required increase in yields must come from wider application of improved farming technology and from crop genetic research leading to greater photosynthetic efficiency. At present, less than 1/10 of 1 per cent of sunlight incident upon cultivated fields each year is utilized by average crop plants to produce edible products. With high-yielding agriculture such as that practiced in the corn belt of the midwest of the United States, close to 1 per cent of the sunlight incident during the growing season is utilized. Thus, there is a wide scope for improvement in photosynthetic efficiency in the world's farmlands. Even an increase in efficiency to 0.2 per cent would give annual production of about four tons/hectare.

We may conclude that the feasibility of providing an adequate diet for future world populations is not limited by the potential biological productivity of crop plans or by the physical characteristics of the world's actual and potential agricultural lands. Considerations of the carrying capacity of these lands are far less important than the social, economic and political conditions which today hold so many of the world's peoples in poverty and malnutrition.

One political and economic condition that is likely to prove intractable is the large difference in food supplies among different countries. To achieve a more equitable distribution large quantities of food would need to be exported from the currently rich countries to the currently poor ones. For our assumed average production of 3.4 tons per hectare, the developed countries, with a total population of about 1,380 million people in 2025, would increase their production of human foods and feed for livestock to 15,400 kcal/person/day, giving a potential human diet of 1,465 kcal in animal



products and 1,835 kcal in plant foods, for a total of 3,300 kcal. This is a higher proportion of animal products than is used today even in Canada, Belgium or Denmark which, according to FAO have the highest consumption of animal products in the world, and a total protein intake at least double their nutritional requirements. On the other hand, for the same productivity per hectare, developing countries with 1000 million hectares of arable land and 6,820 million persons in 2025, would be able to consume only about 275 kcal in animal products/person/day, corresponding to 17 grammes of animal protein. This would be a significant improvement over their present diets, which average 12 grammes of animal protein per day, which, however, is only 19 per cent of the animal protein supply in the developed countries. To come up to our postulated world average of 7,000 kcal/person/day, the developing countries would need to import nearly 1,600 million tons in terms of grain equivalent. At present prices, this would cost about \$ 300 billion a year. Without a very high rate of economic growth over the next 45 years, it would be impossible to reach such a level of imports.

It seems evident that the developing countries have only four possible courses of action: (a) to accept a relatively small improvement of their present meager diets; (b) to raise their agricultural productivity considerably above the level we have assumed for the world average; (c) to increase the area of cultivated land more rapidly in the future than has been the case in the past few years; or (d) to develop export industries on a very large scale and to use the funds received to buy food from the developed countries.

In Africa and Latin America, option (c) would not seem unreasonable, it is the traditional way in which human beings have increased their food supply. It was previously estimated that outside the humid tropics, 500 million hectares of potentially arable land existed in Africa, while the land now cultivated amounts to only 169 million hectares. Similarly, in South America there are an estimated 350 million hectares of potentially arable land outside the humid tropics; while only 105 million are cultivated. As already pointed out, however, Asia which is estimated to have a population in 2025 of 4,550 million has just about reached the limit of its potentially arable land; nearly all of this outside the humid tropics is already cultivated.

The Asian areas within the humid tropics, that is, within the climatic zone where precipitation exceeds potential evapotranspiration throughout the year, occur very largely on the sparsely settled islands of Borneo, northwestern New Guinea, and Sumatra. A relatively small proportion exists in the island of Java, Malay Peninsula and the Philippines. Recent work by members of the Agro-Ecological Zones Project of FAO indicates that only about 14 million hectares out of a total area of 85 million humid tropic hectares in Asia are suitable or marginally suitable for rice cultivation even under a high level of technology. A much smaller area is marginally suitable for cultivation of cassava. Investments needed to bring these humid tropic regions under cultivation and to create new farming communities within them would probably be better spent on raising the productivity of land now cultivated, by increasing both the intensity of cultivation - that is, the number of crops grown per net cultivated hectare - and the yields per crop.



Under rain-fed conditions, agricultural modernization would enable two crops to be grown on about 50 million now cultivated hectares. A much more important step would be to enlarge the currently irrigated area. Indeed, additional water control through irrigation is essential to raise rice production, the staple food of half the people of Asia. If 50 per cent of the estimated total discharge of 6,750 cubic kilometres in Asia rivers could be diverted for irrigation, the irrigated area could be increased by 210 million hectares above the present level of 131 million hectares. Here we have assumed a volume of irrigation water of 10,000 cubic metres per hectare which should provide enough water for one additional crop. Counting the proposed double-cropped, rain-fed area, two crops could be grown on 390 million hectares, and the total gross-cropped area could be raised to 850 million hectares. With an average diet based on 7,000 kcal/day of primary plant materials for 4,550 million people, production would need to be 3.95 tons of human food and animal feed per gross cultivated hectare.

Much higher yields would be required for such already crowded countries as Bangladesh which possesses only 8.1 million net cultivated hectares, yet is expected by the United Nations Population Division to have a population of 222 million people in the year 2025. Here we face a paradox and a dilemma. Introduction and use of the required high-level technology of agriculture implies a large measure of economic and social development. Such development would, in itself, probably result in a decline of birth rates and a stabilization of population size at a lower level than that projected by the United Nations. On the other hand, if Bangladesh does not become self-sufficient in food production, large-scale export-oriented industrialization would be necessary to provide foreign exchange for food import, and this also would require economic and social development, presumably accompanied by declining birth rates.

The construction projects necessary to expand the Asian irrigated area and to improve present irrigation systems would include building surface reservoirs and canal systems, tube wells, electrification for these wells, flood control works and major drains. The agricultural infrastructure also needs to be strengthened by land levelling and grading, the provision of field drains, and the construction of fertilizer plants, factories for tools, machinery and pesticides, farm-to-market roads, and marketing, storage and food-processing facilities. Capital costs would be of the order of \$ 2,000 per hectare, say \$ 700 billion for 340 million net irrigated hectares. Evenly divided over the next 45 years, annual capital expenditures should be about \$16 billion, roughly \$ 6 per person per year for the 1980 population of Asia. This is less than 2 per cent of the Asian gross product in 1980 and 10 to 15 per cent of annual capital expenditures.

Because of the demographic momentum related to the unbalanced age distribution, population growth will continue after 2025, even if a net reproduction rate of one is achieved. Agricultural productivity should also rise, however, because of the "fertilizer" effect of rising atmospheric carbon dioxide.

Carbon dioxide levels are expected to double some time in the second half of the twenty-first century, correspondingly, the rates of photosynthesis



should rise by 30 to 50 per cent. If this increase in photosynthesis can be translated into increased food supply, it should be possible to accommodate the post-2025 increase in population.

The population/resource equation in Asia is less favourable when we consider future energy requirements than in the case of land and water resource. Production of 3.95 tons of cereal equivalent per gross-cultivated hectare would require the energy of 140 kilogrammes of coal-equivalent persons (1 kilogramme of coal-equivalent is defined by the United Nations as containing 7,000 kcal). This is about 20 per cent of present energy use in the Asian countries. Nevertheless, the quantity of energy utilized must rise rapidly in the future, even to ensure adequate food supplies, let alone to improve the conditions of life.

The necessary transformation from subsistence to market agriculture cannot occur without overall social and economic development and this will require greatly increased energy use - particularly in industry, construction and transportation. Industrial development is basic for employment creation and capital formation. Construction is essential for building agriculture and other infrastructures, and economic integration for higher productivity in all sectors of the economy depends on increasing the efficiency and volume of transportation. Present annual per capita energy use is probably about 700 kilogrammes. At an annual growth rate of 2.25 per cent, this would rise to two tons per caput by 2025. The total energy demand of the Asian countries would then amount to about 9,000 million tons of coal-equivalent. We must ask ourselves whether this growth in demand could be met by available energy resources and for how long. The total recoverable fossil fuels, including coal, oil and natural gas in South and Southeastern Asia have been estimated at only 72,000 million tons, or 27 tons per caput for the expected population in 2025. For an annual per capita energy use of two tons, these resources would be depleted in 13.5 years. The situation is much better for China and Southwestern Asia. Two hundred and sixty-nine years would be required for depletion of China's extensive coal resources, and 440 years for depletion by the local population of the oil and gas resources of Southwestern Asia.

On the average, "renewable" energy resources - hydropower, geothermal electric generation and wood could meet all the energy needs of the developing countries up to the year 2025. Again the catch is maldistribution (see table 7). Though renewable resources are abundant in Africa and South America, they could meet less than half our calculated energy needs in 2025 for South and Southeastern Asia.



Table 7. Estimated principal potential renewable energy resources  
(Tons of coal-equivalent)

	(1)		(2)		(3)		(4)	
	Hydroelectric power		Geothermal electric potential		Wood from forest plantations		Total	
	(total) (10 <sup>9</sup> tons)	(per caput) (tons/yr <sub>a</sub> /)	(total) (10 <sup>9</sup> tons)	(per caput) (tons/yr <sub>a</sub> /)	(total) (10 <sup>9</sup> tons)	(per caput) (tons/yr <sub>a</sub> /)	(total) (10 <sup>9</sup> tons)	(per caput) (tons/yr <sub>a</sub> /)
Africa	.19	0.4	.08	0.2	2.48	5.4	2.77	6.1
Asia	.33	0.1	.20	0.1	1.88	0.75	2.41	0.96
China, Viet Nam, Dem. People's Rep. of Korea	(.19)	0.2	(0.10) b/	0.1	(0.56)	.55	(.85)	0.84
South and East Asia	(.14)	0.1	(0.10) b/	0.1	(1.32)	0.9	(1.56)	1.05
North America	.19	0.5	0.21	0.6	2.44	6.7	2.84	7.8
South America	.23	1.0	0.23	1.0	3.12	13.0	3.58	15.0
Europe	.09	0.2	.015	.03	0.52	1.1	.625	1.3
USSR	.13	0.5	.065	0.25	3.12	11.8	3.315	12.6
Oceania	.025	1.1	.18	8.2	0.52	23.6	.725	33.0
<u>World total</u>	1.19	0.26	.98	0.22	14.08	3.1	16.25	3.61
<u>LDC total</u>	.80	0.25	.51	0.16	7.48	2.33	8.79	2.74

Sources: For column (1), E. L. Armstrong, "Hydraulic resources", in World Energy Resources, 1985-2020, Report of the Conservation Commission of the World Energy Conference (New York, IPC Science and Technology Press, 1978), pp. 87-108; for column (2), P. L. Auer, P. B. Bos, V. W. Roberts and W. C. Gough, "Unconventional energy resources", in ibid. pp. 161-173; for column (3), Computed by author. Assuming that 20 percent of the forested area of each continent (as given in the FAO Production Yearbook, 1979) would be replanted in fast-growing trees yielding 30 tons of dry wood annually, with energy content of  $4 \times 10^6$  kcal/ton.

a/ 1979 population from Demographic Yearbook, 1980 (United Nations publication, Sales No. E.F.81.XIII.1).

b/ Assumed by author; source gives only total estimated geothermal resources for Asia.



## C. Food production and population growth in Africa

United Nations\*

### Introduction

Africa in the eighties is facing critical economic and socio-political problems; but perhaps the most intractable of all is the phenomenon of increasing population and rising urbanization at a time of falling food production and reduced agricultural productivity. Over the past two decades, the food and agriculture situation in Africa has undergone drastic deterioration and the situation is now reaching crisis proportions. Various studies and documentation which attest to this situation have in one way or another proposed action plans and programmes for remedying the situation. Various international meetings have focused on the same topic and calls have been made for immediate remedial action. Most recently, at the Twelfth Regional Conference for Africa of the Food and Agriculture Organization of the United Nations (FAO) (held in Algeria in September 1982) the Director-General of FAO pointed out that Africa's home-grown food supplies have decreased by more than 10 per cent in as many years, making the continent's food crisis one of the biggest development problems in the world. "The only chance for a cure", he said, "lies in a very pronounced increase in internal production of food-stuffs".

As far back as 1974, the World Food Conference adopted resolution IX on the achievement of a desirable balance between population and food supply;<sup>1/</sup> and called on all Governments to make every effort to grow and equitably distribute, sufficient food and income so that all human beings may have an adequate diet. Later on in November 1976, the FAO Regional Conference in Freetown further called on the FAO, Economic Commission for Africa (ECA), and the Organization for African Unity (OAU), to draw up a regional food plan which would enable all member States of the OAU to be self-sufficient in food production within a period of 10 years. The Conference of Ministers of the ECA, held in Kinshasa in February 1977, endorsed this Freetown Declaration.

The Regional Food Plan for Africa was approved in Arusha (Tanzania) at the Tenth FAO Regional Conference for Africa in September 1978. Subsequently, the Lagos Plan of Action of 1980, a document regarded as the contemporary blue print for African development, has food self-sufficiency for Africa as its major objective. Guidelines for the attainment and implementation of self-sufficiency in food, as presented in the Implementation Plan of the Lagos Plan of Action, was approved by the heads of State and Governments of the OAU.

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\* Economic Commission for Africa.



The sad affair of dealing with food production and deteriorating agricultural productivity in Africa can be explained by a number of factors. First, agricultural policies encouraged and practised in the countries of the region have not been particularly favourable to the indigenous food supply situation and have been directed more towards the development of income-generating industrial crops. Similarly, investment in agricultural research has been very meagre and geared more towards these export crops.

A main disincentive to increased agricultural production in the countries of the African continent is to be found in the pricing systems practised in the countries. Prices of agricultural commodities and food products are controlled at too low a level in order to benefit urban consumers. Another disincentive is to be found in the urban-oriented investment strategies of many countries. Many Governments have proclaimed agriculture and rural development to be the cornerstone of their national development plans, but few have actually allocated more than 5 to 10 per cent of their budgets to agriculture in recent years; and this is in spite of the dominating importance of agriculture in their economies.

That the chronic lack or inadequacy of infrastructures, institutions and supporting services, especially in relation to education and health, is a serious constraint to rapid increases in food production in Africa needs no elaboration. The adverse effects of inadequate programmes for credit, marketing, extension and training as well as the devastating effects on the agricultural labour force of poor health and education are all too well known. As stated in the Regional Food Plan for Africa 2/, "Indeed, it is only through a considerable expansion and improved efficiency of the supporting services that technological innovations and modern inputs can be expected to reach the mass of the rural poor and enable the traditional subsistence farmer to produce food for the market".

Africa has equally had more than her fair share of disasters, both natural and man-made: these have further complicated the problem of inadequate food and agricultural production. Large areas of Africa have been made desolate, unproductive or increasingly less productive through the effects of drought, desertification, overgrazing, soil erosion, diseases, pests and hostilities. Deserts in Africa have been encroaching on useful agricultural land at the rate of 60,000-70,000 square kilometres per year and are affecting the livelihood of about 60 million people directly. The Sahelian drought of 1968 to 1974 claimed the lives of over 150,000 people and millions of cattle and other livestock in the region.<sup>3/</sup> More recently, drought has reappeared with increasing intensity since 1978, in the Sudan-Sahelian region, the Horn of Africa as well as in Southern Africa near the Kalahari Desert region. It is estimated that every year, some 25,000 square kilometres of African land is being lost for food production and rural income earning capacity because of soil erosion. The increasingly devastating effect wrought on good agricultural land in Africa through the ravages of war needs no elaboration.

Last, but by no means least, there is the adverse effect of the rapid growth of population and the increasing rate of urbanization in Africa on the food situation. Population in Africa in the past decade has been increasing



at a rate close to 3 per cent while food production grows at less than 2 per cent per year, implying a serious decrease in per caput terms. The annual rate of decrease in average per caput food production during the 1960s (-0.7 per cent) actually worsened during the 1970s (-1.6 per cent) <sup>4/</sup> and estimates for the period 1980-1982 point to a further deterioration. To complicate this unwholesome phenomenon, urbanization has been choking Africa's ill-equipped townships at annual rates, which, in many cases, are double the total population growth rates, and sapping the rural areas of their youth and essential manpower.

This paper, which explains why food production fails to match population growth includes a discussion on dietary and nutritional requirements, and other factors determining the demand for food, and the role of rural labour force productivity. An attempt is made to discuss the projections of food production and demand using two variants and policies and measures required to improve food production in Africa. Recommendations on appropriate strategies are submitted for evolving a short-term solution to the problem.

### Trends in food production, nutrition and population, 1970-1981

#### Food supply

The food problem manifests itself in different forms in the different regions and countries of Africa. For example, whereas Zimbabwe is self-sufficient, other countries, though not self-sufficient, are able, financially, to import the required foodstuffs to supplement local production. But, in most other countries there are serious financial constraints against the import of foodstuffs to meet the shortfall in supply. In this regard and due to lack of adequate information or problems of reliability of the data, there is need for caution in overall generalizations on the food and population problem in Africa.

While the food production growth rate for the world as a whole was 2.4 per cent per year during 1970 to 1976, which was much greater than the population growth rate of 1.9 per cent per year, Africa's food production growth rate for the same period was 1.2 per cent and far below Africa's population growth rate of 2.7 per cent. (See table 1). In fact, during this period it was only the African region that indicated a population growth rate that exceeded food production growth rates. This drop in food production was more pronounced with the cereals production growth rate of 1.9 per cent per year, hence the rapid growth rate of cereals imports in the early seventies which has been rising steeply ever since.

In an increasing number of countries, population growth rates have been outstripping food production growth rates. During the period 1970 to 1976, population growth rates were greater than food production growth rates in two thirds of the countries as compared to half, for the earlier period, 1961/65 to 1970 (table 2). Furthermore, total food production growth rates (table 3) for the period 1970-1977 were highest in Northern Africa (2.1 per cent), followed by Eastern and Southern Africa (1.9 per cent). In Western and Central Africa, the rates were 1.1 per cent and 1.0 per cent respectively.



**Table 1. Average annual rates of growth of population and food, world and main regions, 1970-1976 (Percentage)**

Region	Average annual population growth rate	Average annual growth rates in total food production	Annual growth rates in total cereal production
World	1.9	2.4	2.7
Africa	2.7	1.2	1.9
North America	0.9	3.1	4.1
Western Europe	0.6	1.6	1.3
Eastern Europe and USSR	0.9	1.9	1.6
Latin America	2.8	3.3	3.8
Western Asia	2.8	4.2	5.0
Asia and the Pacific	2.5	2.8	2.3
Oceania	1.7	3.1	6.5

**Source:** World Population Trends and Policies: 1979 Monitoring Report, Vol. I: Population Trends (United Nations publication, Sales No. E.79.XIII.4), pp. 200-201.



Table 2. Rates of population growth, food and cereal production for some of the countries in Africa, 1970-1976 (Percentage)

Country	Population	Production		Production per capita	
		Food	Cereals	Food	Cereals
Algeria	3.2	2.5	4.5	-0.7	1.3
Angola	2.3	-0.2	0.3	-2.4	-2.0
Benin	2.7	-2.6	4.0	1.9	-2.2
Botswana	2.3	4.8	30.8	2.4	28.5
Burundi	2.4	2.1	4.0	-0.4	1.5
Cameroon	1.9	1.2	2.8	-0.7	0.9
Cape Verde	1.9	6.8	54.6	4.8	52.7
Central African Republic	2.1	1.0	-2.8	1.1	-4.8
Chad	2.0	-0.1	-1.9	-2.9	-3.9
Comoros	2.5	2.5	6.8	-	4.2
Congo	2.5	1.4	23.3	-1.0	20.8
Egypt	2.4	2.1	1.4	-0.2	-1.0
Ethiopia	2.4	-1.4	-3.3	-3.7	-5.6
Gabon	1.0	1.4	12.4	0.5	11.4
Gambia	1.9	5.1	3.2	3.1	1.2
Ghana	2.8	-0.1	-1.1	-2.8	-3.8
Guinea	2.4	-0.3	-2.2	-2.6	-4.5
Guinea-Bissau	1.6	1.4	2.7	-0.2	1.1
Ivory Coast	2.5	4.9	5.5	2.4	2.9
Kenya	3.3	0.2	-0.8	-3.1	-4.0
Lesotho	2.0	1.2	-2.3	-0.8	-4.2
Liberia	2.3	4.5	11.5	2.1	9.2
Libyan Arab Jamahiriya	3.1	10.2	27.8	7.1	24.7
Madagascar	3.0	1.2	0.1	-1.3	-2.8
Malawi	2.4	2.7	1.9	1.2	-0.5
Mali	2.5	-0.3	2.1	-2.7	-0.3
Mauritania	2.0	-3.9	-6.2	-5.8	-8.2
Mauritius	1.8	0.8	-	-0.9	-
Morocco	3.0	0.8	-	-2.1	-2.9
Mozambique	2.3	-0.9	0.9	-3.1	-1.4
Niger	2.7	-1.1	1.0	-3.7	-1.7
Nigeria	2.7	-0.5	1.0	-3.1	-1.7
Rwanda	2.7	2.8	-0.2	0.1	-2.9
Senegal	2.4	9.1	7.0	6.7	4.5
Sierra Leone	2.5	2.0	3.6	-0.4	1.1
Somalia	2.6	-0.6	0.3	-3.2	-2.3
Sudan	3.1	5.4	5.4	2.2	2.2
Swaziland	2.8	4.6	3.2	1.8	0.4
Togo	2.8	-7.5	-4.7	-9.4	-7.5
Tunisia	2.3	6.5	7.9	4.1	5.5
Uganda	3.0	1.2	3.6	-1.7	0.6
United Republic of Tanzania	3.1	5.9	14.4	2.8	11.3
Upper Volta	2.3	1.6	4.9	-0.7	2.6
Zaire	2.5	1.3	1.7	-1.1	-0.8
Zambia	3.2	6.3	5.2	3.0	2.0
Zimbabwe	3.4	4.1	7.9	0.7	4.5

Source: World Population Trends and Policies: 1979 Monitoring Report.  
Vol. I: Population Trends (United Nations publication, Sales No. E.79.XIII.4).



Table 3. Average annual growth rates in total food production and per capita food production in Africa, 1970-1977, by sub-region (Percentage)

Sub-region <sup>a/</sup>	Total food production	Per caput food production
Northern Africa	2.1	-0.7
Western Africa <sup>b/</sup>	1.1	-1.5
Central Africa	1.0	-1.3
Eastern and Southern Africa	1.9	-0.9
Africa	1.3	-1.4

Source: Food and Agriculture Organization of the United Nations, Regional Food Plan for Africa, Tenth FAO Regional Conference for Africa, Arusha, United Republic of Tanzania, Arusha, 18-19 September 1978 (Rome, 1980).

<sup>a/</sup> The countries or areas in each sub-region are as follows:

North Africa: Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Sudan, Tunisia.

Sahel: Cape Verde, Chad, Gambia, Mali, Mauritania, Niger, Senegal and Upper Volta.

Western Africa: Benin, Cameroon, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Nigeria, Sierra Leone and Togo.

Central Africa: Angola, Central African Republic, Congo, Equatorial Guinea, Gabon, Sao Tome and Principe, and Zaire.

Eastern and Southern Africa: Botswana, Burundi, Comoros, Djibouti, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Réunion, Rwanda, Seychelles, Somalia, Swaziland, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

<sup>b/</sup> Includes the Sahel.



For Africa as a whole, the growth rate was 1.3 per cent which was much lower than the 2.7 per cent for the previous period of 1961-1970. In each sub-region there was, however, a negative food per capita growth rate for the period 1970-1977. While the food per capita growth rate for Africa as a whole was negative (-1.4 per cent) for the period 1970-1977, the corresponding figure for 1961-1970 was 0.03 per cent per year; thus reflecting a serious decline in total as well as per capita food production during the 1970s.

Trend production figures for the various food commodities for the years 1970 to 1980 presented in table 4 reveal that but for sugar and meat the growth rates for these products were less than 2 per cent, and while the total food production growth rate was 1.5 per cent for the period 1970 to 1980, population in Africa was growing at almost twice the rate of food production. Data on production growth rates for cereals and food generally during 1970-1978, 1978-1981 and 1980-1981 by country groupings excluding South Africa are shown in table 5. For the cereals group, wheat production deteriorated and the growth rates were -.29 per cent, -1.31 per cent and -11.98 per cent during 1970-1978, 1978-1981 and 1980-1981, respectively. For rice paddy, the growth rate at 7.33 per cent during 1978-1981 was much higher than that for 1980-1981 at 4.09 per cent. In 1980-1981, growth rates for maize, millet and sorghum were 7.03 per cent, 3.88 per cent and 8.47 per cent per year respectively, an increase from the corresponding rates for the period 1978-1981 of 1.54 per cent, -.52 per cent and 1.79 per cent.

A comparison of population growth and cereal production during 1976 to 1980 is presented in table 6 for all the ECA member states. This table shows that in nearly 75 per cent of the countries, annual rates of change in population were greater than annual rates of change in total cereal production and this imbalance in population growth rate with cereals production calls for serious attention to the need for improved food production.

#### Dietary and nutritional needs

Malnutrition is another disturbing and pernicious problem affecting Africa today and is in itself a consequence of inadequate food supply. It is sad that over the past two decades food consumption per person in Africa has fallen below nutritional requirements.<sup>5/</sup> It was estimated that in 1970, 25 per cent of the African population had inadequate protein/energy supply in their diets.<sup>6/</sup> Lack of adequate food production, lack of knowledge of proper preparation and use of food, taboos for eating certain food, and poverty in general are also contributing factors. Malnutrition is a condition that should not be tolerated since it allegedly contributes to morbidity, high mortality and reduces the individual's productivity. Unfortunately, young children, pregnant women and lactating mothers and the very old or incapacitated are the most vulnerable groups. In 1961 Africa's average daily dietary consumption as a percentage of requirements per capita was 92 per cent and this did not improve a decade later (in 1970).<sup>7/</sup> In 1977 about 10 per cent of the 37 countries in Africa for which data were available had their per caput dietary energy supplies requirements met by up to 100 per cent or more,<sup>8/</sup> but unfortunately 90 per cent of the countries also had inadequate supplies. This pattern of nutritional deficiency is explained by a fall in



Table 4. Food production in Africa excluding South Africa,  
1970-1980, and growth rates

Crop	------(thousands of metric tons)-----				Percentage growth rate 1970 to 1980	
	1970	1977	1978	1979		
Wheat	6,514	5,813	7,069	6,705	7,164	0.96
Paddy rice	7,373	7,961	7,845	8,367	8,426	1.34
Millet	7,389	9,467	10,386	9,986	10,152	0.78
Sorghum	8,846	9,819	9,722	9,715	9,710	0.94
Maize	14,443	16,576	18,012	16,112	16,961	1.62
Cereals (total)	51,641	53,827	58,439	56,040	58,368	1.23
Roots and tubers (total)	68,366	77,658	78,707	80,560	83,207	1.98
Pulses (total)	4,910	4,763	4,930	5,026	4,959	0.10
Ground-nuts in shell	4,903	4,518	4,855	4,805	4,456	-0.95
Centrifugal sugar (raw value)	3,165	3,957	4,119	4,295	4,343	3.21
Meat (total)	4,392	4,959	5,170	5,329	5,529	2.33
Cow milk (whole fresh)	6,468	7,453	7,679	7,656	7,842	1.94
Total	190,410	206,771	216,933	214,596	221,117	1.50

Sources: Economic Commission for Africa, Survey of Economic and Social Conditions  
in Africa, 1980-1981 (E/ECA/CM.8/17) 11 March 1982.



Table 5. Gross production exponential growth rates for some food commodities by country grouping a/, in Africa 1970-1978, 1978-1981 and 1980-1981 (Percentage)

Food commodity	Country grouping	1970-1978	1978-1981	1980-1981
Wheat	North Africa	- .26	- 1.84	-14.69
	West Africa	1.53	.25	.27
	Eastern and Southern Africa	- .69	1.62	5.61
	Central Africa	- 3.38	3.64	- 2.03
	Great Lakes	3.72	8.59	2.72
	Africa (excluding South Africa)	- .29	- 1.31	-11.98
Rice, paddy	North Africa	- 1.18	.51	6.92
	West Africa	3.42	12.95	6.23
	Eastern and Southern Africa	.30	1.56	- 4.92
	Central Africa	2.94	5.66	2.26
	Great Lakes	3.38	3.75	.81
	Africa (excluding South Africa)	1.34	7.33	4.09
Maize	North Africa	3.32	4.99	-19.98
	West Africa	1.96	3.32	2.95
	Eastern and Southern Africa	2.47	3.88	28.63
	Central Africa	2.02	1.28	- 3.08
	Great Lakes	2.59	.82	3.74
	Africa (excluding South Africa)	2.46	1.54	7.03
Millet	North Africa	- 1.53	- 2.12	4.90
	West Africa	1.52	.09	5.39
	Eastern and Southern Africa	.26	- 2.94	- 2.00
	Central Africa	1.22	- .18	- .80
	Great Lakes	3.07	- 8.62	-23.01
	Africa (excluding South Africa)	.89	- .52	3.88
Sorghum	North Africa	3.67	8.95	26.51
	West Africa	1.47	.57	3.70
	Eastern and Southern Africa	.79	- .66	5.83
	Central Africa	.86	- 6.37	73.67
	Great Lakes	3.81	-10.69	5.69
	Africa (excluding South Africa)	1.59	1.79	8.47
Cereals	North Africa	.38	- 1.79	-11.42
	West Africa	1.95	3.81	4.75
	Eastern and Southern Africa	.92	2.33	11.93
	Central Africa	1.70	1.22	- .95
	Great Lakes	3.00	- 2.79	1.83
	Africa (excluding South Africa)	1.13	1.50	.81



Table 5 (continued)

Food commodity	Country grouping	1970-1978	1978-1981	1980-1981
Food	North Africa	2.16	2.53	- .80
	West Africa	1.77	3.91	3.20
	Eastern and Southern Africa	1.59	1.77	5.17
	Central Africa	1.68	2.17	2.42
	Great Lakes	1.97	1.94	2.87
	Africa (excluding South Africa)	1.82	2.88	2.54

Source: Food and Agriculture Organization of the United Nations, computer print-outs, 18 August 1982.

a/ The countries or areas in each subregion are as follows:

North Africa:	Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Spanish North Africa, Sudan, Tunisia, Western Sahara.
West Africa:	Benin, Cape Verde, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, Upper Volta, St. Helena.
Eastern and Southern Africa	Botswana, Comoros, Djibouti, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Seychelles, Somalia, Swaziland, Uganda, United Republic of Tanzania, Zambia, Zimbabwe, British Indian Ocean Territories.
Central Africa:	Angola, Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, Sao Tome and Principe.
Great Lakes:	Burundi, Rwanda, Zaire.



Table 6. Total population, agricultural population, total labour force and agricultural labour force in 1981, annual rates of change in total cereal production, 1976-1980, and value of imports of cereals in ECA member states, 1980.

Country	Total population in 1981	Agricultural population in 1981	Total labour force in 1981	Agricultural labour force in 1981	Annual rate of change in total population 1976-1980	Annual rate of change in total cereals production 1976-1980	1980 value of cereals imported (\$ US million)
					----- (thousands) -----	----- (%) -----	
Algeria	19,259	9,502	4,272	2,129	3.5	4.5	668.60
Angola	7,263	4,193	1,914	1,105	2.5	- 8.3	63.30
Benin	3,641	1,671	1,673	768	3.0	7.7	19.20
Botswana	845	678	393	315	2.8	-37.1	25.26
Burundi	4,643	3,854	2,216	1,840	2.9	0.1	12.17
Cameroon	8,646	6,978	4,012	3,238	2.3	1.7	57.28
Cape Verde	329	185	104	58	1.7	4.4	7.53
Central African Republic	2,275	1,986	1,228	1,072	2.3	2.5	7.04
Chad	4,636	3,877	1,776	1,485	2.4	1.7	5.35
Comoros	343	218	124	79	2.3	2.8	5.42
Congo	1,577	539	540	185	2.6	- 2.0	24.27
Djibouti	122	60	38	19	2.4	-	10.25
Egypt	43,054	21,695	12,120	6,107	2.7	0.7	1,141.12
Equatorial Guinea	372	278	110	82	2.4	2.2	-
Ethiopia	33,467	26,486	13,792	10,915	2.5	- 0.1	71.12
Gabon	558	426	266	203	1.2	2.5	16.07
Gambia	619	483	302	235	2.8	- 0.7	11.16
Ghana	12,053	6,180	4,466	2,268	3.2	3.5	69.13
Guinea Bissau	584	480	179	147	1.8	-18.2	5.25
Ivory Coast	8,229	6,529	4,112	3,262	3.4	4.3	136.75
Kenya	17,047	13,223	6,445	5,000	3.9	-10.4	85.85
Lesotho	1,373	1,150	720	603	2.4	10.6	16.58
Liberia	1,926	1,343	706	492	3.4	- 0.3	45.16
Libyan Arab Jamahiriya	3,096	485	778	122	4.1	- 2.2	199.45
Madagascar	8,983	7,481	4,381	3,649	2.7	1.3	78.90



Table 6 (continued)

Country	Total population in 1981	Agricultural population in 1981	Total labour in 1981	Agricultural labour force in 1981	Annual rate of change in total population 1976-1980	Annual rate of change in total cereals production	1980 value of cereals imported (\$ US million)
					-----	-----	-----
					(thousands)	(%)	
Malawi	6,370	5,333	2,839	2,377	3.3	0.3	33.61
Mali	6,833	5,942	3,671	3,192	2.8	- 4.2	18.09
Mauritania	1,682	1,393	514	425	2.9	- 4.6	38.05
Mauritius	1,014	286	366	103	2.0	-17.7	58.93
Morocco	20,970	10,726	5,532	2,830	3.3	- 1.4	354.17
Mozambique	10,759	6,931	4,060	2,616	2.6	-10.9	96.33
Niger	5,466	4,804	1,698	1,493	3.0	6.8	20.05
Nigeria	79,682	42,341	30,040	15,996	3.3	3.0	606.03
Rwanda	4,951	4,433	2,583	2,313	3.1	2.3	7.93
Sao Tome and Principe	86	46	22	11	1.2	2.7	2.77
Senegal	5,811	4,323	2,405	1,789	2.6	0.3	112.27
Sierra Leone	3,571	2,324	1,333	868	2.7	- 3.9	30.62
Somalia	3,752	3,003	1,441	1,153	2.9	- 2.1	81.83
Sudan	18,895	14,523	5,857	4,502	2.8	3.8	78.54
Swaziland	572	415	261	189	2.9	- 4.2	7.24
Togo	2,784	1,890	1,143	775	3.1	2.9	16.74
Tunisia	6,525	2,647	1,565	635	2.6	5.6	175.50
Uganda	13,623	11,018	5,588	4,520	3.1	- 3.4	12.90
United Republic of Tanzania	18,511	14,999	7,551	6,118	3.1	- 1.2	110.48
Upper Volta	7,094	5,773	3,768	3,067	2.6	2.0	39.37
Zaire	29,084	21,598	12,259	9,103	2.8	1.2	117.03
Zambia	5,830	3,885	2,116	1,410	3.3	- 9.0	107.53
Zimbabwe	7,650	4,487	2,511	1,473	3.5	- 3.0	25.86

Source: Food and Agriculture Organization of the United Nations, country tables - basic data on the agricultural sector (Rome, 1982).



the production of the basic foods such as cereals, pulses, meat and fish. The pattern of deficiencies varies in the different subregions of the African continent as indicated in the food self-sufficiency ratios (SSR) shown in table 7.

Even though Northern Africa managed to meet its large food deficits, mainly through imports, energy supplies remained far below requirements in the other subregions and critically so in the Sahel.<sup>9/</sup> (See table 6 for values in United States dollars of cereal imports for 48 African countries.) In a similar vein, there are differences in nutritional levels within respective countries. For example, the per capita consumption of animal protein is generally greater in the large urban areas than in rural areas: the relatively higher incomes in the large towns generate relatively higher demand for animal protein-rich foods.<sup>10/</sup> Urbanization on the whole stimulates higher demand for convenience foods (bread and other flour preparations) as well as animal protein foods over and beyond the domestic level of aggregate supply, thus necessitating imports. In countries lacking foreign exchange, higher demand generates higher prices for these foods, thereby making them unavailable to the poorer classes, particularly the rural dwellers, the young, the weak and the most vulnerable - the aged.

Furthermore, rapid urbanization has also created a poverty-stricken urban class which is particularly vulnerable to malnutrition and under nourishment.<sup>11/</sup> As long as food production does not increase substantially to meet the demand, rapid population growth and urbanization will perpetuate malnutrition, poor health, low productivity, low income and bring little hope of savings and economic development in the immediate run.

Improvements in nutrition, therefore, will contribute to improved health and reduction of morbidity and mortality. Strategies for improving nutrition should involve the integration of nutrition in the overall development programme for increased food production, increased employment and increased incomes for the rural population. Mass media education on nutrition, health and family planning would also contribute greatly to resolving some of the nutritional problems in Africa.

#### Rural labour and agricultural productivity

In all African countries, the rural population provides over 90 per cent of the labour force engaged in agriculture and food production. Data in table 6 indicate that the agricultural labour force was more than 70 per cent of the total labour force in many countries in 1981. Africa in general has at present a favourable manland ratio which is an advantage in being able to expand food production. For example, in 1979, the number of persons per square kilometre of arable land in Africa was 278, while figures for some of the other regions for the same period were: 348, for Latin America; 592, for Asia; and 380, for Europe.<sup>12/</sup> Although some efforts have been made to expand cultivable land in some of the African countries recently, expansion of arable land has been constrained by an increase in the growth of agricultural population and under-utilized labour force, and reduced productivity. For instance, the average annual percentage growth in total agricultural



Table 7. Levels of self-sufficiency ratios (SSR) in basic foods a/

	1972-1974		1985 MPD <u>c/</u>		1990 MPD <u>c/</u>	
	<u>Balance</u> (1000 mt)	<u>SSR b/</u> (%)	<u>Balance</u> (1000 mt)	<u>SSR b/</u> (%)	<u>Balance</u> (1000 mt)	<u>SSR b/</u> (%)
Northern Africa	-5,798	78	-5,698	85	-5,775	88
Sahel	-1,000	83	-495	95	-545	95
Western Africa	-1,921	94	-2,190	95	-4,252	92
Central Africa	-506	94	-135	101	-181	99
Eastern and Southern Africa	-597	98	-415	99	-277	100
Total Africa	-9,822	90	-8,663	94	-11,030	94

Source: Food and Agriculture Organization of the United Nations, Regional Food Plan for Africa, Tenth FAO Regional Conference for Africa, (Rome, 1980), p. 16.

a/ Cereals, roots and tubers, pulses, meat and fish.

b/ In wheat equivalent calculated on the basis of calories aggregate demand and supply.

c/ Maximum Feasible Production and Demand Variant.



production in Africa fell from 2.7 per cent per year during 1961-1965 to 1970 to 1.1 per cent per year during 1970-1976, and the agricultural production per agricultural person during the same period fell from 1.0 per cent to -0.5 per cent per year while agricultural production per agricultural worker during the same period had fallen from 1.4 per cent to -0.2 per cent per year.<sup>13/</sup>

Productivity in food production is very low in African countries. The FAO 1970 Production Yearbook indicated that a hectare yielded 2,460 kilogrammes of wheat in Europe and 760 kilogrammes in Africa, which is one third of Europe's productivity level. Another example illustrates the same point; in 1974, rice yields (per acre) in Nigeria averaged only one third those in Japan.<sup>14/</sup> Continued rapid population growth is likely to reduce productivity in the short run if no action is taken to expand the production of food, increase yields and improve rural life through the provision of gainful employment in agriculture, the provision of health facilities, transportation, incentives for food production, and a massive introduction of improved technology.

#### Projections of food production and demand towards the year 2000

A number of factors determine the demand for food; among them are population size, structure, growth, income, population composition and urbanization. Increase in population creates additional requirements for food. For the period 1952 to 1972 population growth was estimated to have accounted for up to 70 per cent of the increased demand for food in all developing regions.<sup>15/</sup> For Africa, in 1962 to 1985, this proportion was 77 per cent for population growth while only 23 per cent was due to income increases.<sup>16/</sup> In addition to population growth and income, age composition and structure also affect aggregate demand for food. Population age group, sex and locational distribution and nature of jobs, all exert their influence on food demand. The nature of food demand can also become a critical factor. In the particular case of children, for instance, a change in the population of children may lead to a demand for special children's food if this is popular enough with working mothers. In fact, studies have estimated that changes in sex and age structure can bring about changes of up to 10 per cent in calorie requirements and protein demand.<sup>17/</sup> Similarly a shift of population from rural to urban areas, particularly in Africa can also contribute to reduction in food output in the rural areas.

FAO has made some projections on food production and demand towards the year 2000 using two variants: (a) the trend variant and (b) the better performance or the Maximum Feasible Production and Demand (MPD) variant. Each of these projections for demand for food was linked to (a) a growth assumption for private consumption expenditures (PCE), which in turn was derived from the GDP growth assumptions on the basis of past relationships between PCE and GDP, and (b) the medium population growth projections as assessed by the United Nations.<sup>18/</sup> The trend projections assume that recent trends will continue in the future. Under this set of projections, the annual growth rates in demand for cereals, pulses, vegetables, bananas, other fruit, vegetable oils, milk and fish will continue to exceed the production for the period 1974-1976 to 1985. But for meat, the annual growth rate of production is expected to



exceed demand while for sugar and root crops, the annual production growth rate is expected only to meet demand (see table 8). The trend projections for 1985 to 1990 show that food production growth rates will lag behind the demand for each food commodity mentioned above.

The self-sufficiency ratios for the years 1974-1976 to 1990 are also shown in table 8. The trend in self-sufficiency ratios is rather alarming. There are declines in these ratios for every food commodity up to the year 1990, thus painting a picture that no Government should allow to prevail.

Projections using the MPD variant assumed that there will be significant changes in development activities to stimulate increased food production. Some of the measures to improve food production would include policies on prices of farm produce and inputs to motivate farmers to produce more, better marketing infrastructure, improvements in the transportation network, in storage facilities, and a general improvement of rural life and facilities. Data on the annual growth rates in food production and demand for the periods 1974-1976 to 1985 and to 1990 under the MPD projections are shown in table 9 together with the corresponding self-sufficiency ratios. The figures reveal that for the same corresponding periods:

(a) Both production and demand growth rates will rise to levels higher than the trend projections and the gap between production and demand will be narrower;

(b) Demand growth rates for fish, milk, meat, vegetable oils, bananas and other fruit, pulses and cereals will be higher than production growth rates for the period 1974-1976 to 1985;

(c) However, during 1985 to 1990 annual growth rates for the production of cereals, pulses, vegetable oils, bananas, citrus fruit, sugar, meat and milk are expected to be greater than demand;

(d) Self-sufficiency ratios in cereals will fall in 1985 but rise slightly in 1990;

(e) For the period 1985 to 1990 self-sufficiency ratios of 100 per cent or more are expected in root crops, pulses, vegetables, vegetable oils and fruit;

(f) Self-sufficiency ratios in sugar are expected to increase from 81 per cent in 1974-1976 to 87 per cent in 1985 and 96 per cent in 1990;

(g) Self-sufficiency ratios in meat, milk and fish show a decline from 1974-1976 to 1990.

#### Summary of recommendations and conclusion

A number of factors as indicated in the introduction contribute to the unsatisfactory food situation in Africa. Some of the measures and policies that national Governments need to adopt and implement are presented below and



Table 8. Annual growth rates of production and demand, and self-sufficiency ratios, 1974-1990, based on the trend scenario

Commodity	Annual growth rates (%)		Self-sufficiency ratios			
	1974-1976 to 1985 (production) (demand)	1985 to 1990 (production) (demand)	1974-1976	1985	1990	
Cereals	1.8	2.9	1.8	3.2	83	75 70
Root crops	2.7	2.7	2.5	2.6	100	100 99
Pulses	2.4	2.8	2.9	3.2	104	99 98
Vegetables	3.8	3.9	3.6	3.8	101	101 100
Bananas	1.7	2.5	2.2	2.7	102	95 93
Other fruit	3.4	3.5	3.2	3.5	103	103 102
Citrus fruit	3.7	3.3	2.9	3.6	133	135 131
Vegetable oils	2.3	3.5	3.5	3.9	112	99 98
Sugar	4.0	4.0	3.0	3.7	81	80 78
Meat	7.0	6.0	2.6	4.5	98	81 74
Milk	2.8	4.2	2.8	4.2	82	72 67
Fish	1.7	3.0	2.1	4.0	101	87 85

Source: Food and Agriculture Organization of the United Nations, Regional Food Plan for Africa (Rome, 1980), p. 24.



Table 9. Annual growth rates of production and demand, and self-sufficiency ratios, 1974-1990, based on maximum feasible production and demand (MPD) scenario (Percentage)

Commodity	Annual growth rates		Self-sufficiency ratios			
	1974-1976 to 1985 (production) (demand)	1985 to 1990 (production) (demand)	1974-1976	1985	1990	
Cereals	2.9	3.4	4.1	4.0	83	81
Root crops	2.8	2.8	2.7	2.7	100	100
Pulses	3.0	3.1	3.9	3.7	104	104
Vegetables	4.2	4.1	4.6	4.3	101	105
Bananas	2.3	2.5	3.1	2.8	102	101
Other fruit	3.4	3.5	3.9	4.0	103	103
Citrus fruit	4.5	3.5	5.5	4.3	133	151
Vegetable oils	3.3	3.7	4.3	4.4	112	108
Sugar	5.0	4.2	6.4	4.3	81	96
Meat	3.6	4.3	5.4	5.1	98	95
Milk	3.3	3.8	4.9	4.4	82	80
Fish	2.6	4.1	1.5	2.0	101	82

Source: Food and Agriculture Organization of the United Nations, Regional Food Plan for Africa (Rome, 1980), p. 25.



are consistent with those recommended in the Regional Food Plan for Africa, and the Lagos Plan of Action.

#### Weather and climatic conditions

Weather and climatic conditions are generally beyond human control. However, man's activities do contribute to the worsening of climatic conditions through mismanagement of the environment: indiscriminate cutting of trees, overgrazing, and poor husbandry and farming methods. The worst situation is that presented by perennial drought conditions in the Sahel region, resulting in extended desertification. Needless to re-emphasize is that the deserts in Africa are encroaching on useful agricultural land at the rate of 60,000 to 70,000 square kilometres a year, thereby affecting the livelihood of about 60 million people.<sup>19/</sup> In this regard the Lagos Plan of Action has indicated clearly the need for policies to control erosion and desertification in enhancing food production.

#### Prices

Farmers in Africa have, for very long, been deprived of adequate and remunerative prices for their food and agricultural produce. On the other hand, most African Governments have encouraged subsidized prices for food for urban consumers. Inevitably, such pricing policies have lead to: (a) a deterrent in increasing food production; (b) higher rate of urbanization; (c) further depressed farm gate prices; (d) increased food imports; (e) changing food habits in favour of imported commodities; (f) balance of payment problems; (g) depressed rural economy and out-migration; (h) depressed, unproductive and unremunerative food and agriculture industry; and (i) increased food aid. Furthermore, farm inputs like fertilizers are priced beyond the means of most of the rural population who are engaged in food production. The Lagos Plan of Action and its implementation clearly calls for policies to improve prices in order to create incentives for increased food production.

#### Insufficient expansion of cultivable land

In a number of countries the potential for expansion of cultivable land for food production is very great, e.g., in Ethiopia, where the labour force and land are available. Government policies to motivate the population to expand cultivable land to increase food production are required. In other countries, such as Rwanda where the man/land ratio is high, there is need for a policy to encourage an intensive cropping system with adequate and appropriate research work to generate the essential adaptive technology and skill.



### Cash versus food crops

Some Governments have paid more attention to cash crops than food production. Governments should adopt policies to change such a situation to enable a balance between food production for domestic use and cash crop production in a way to meet rising food demand.

### Post harvest food losses

Food losses before and after harvest contribute significantly to the food problems in Africa. Post-harvest losses are estimated at 10-30 per cent of the total grain harvest and as much as 50 per cent of the harvest of perishable products.<sup>20/</sup> Policies to reduce such losses are called for in the Lagos Plan of Action, which also reiterates a target to reduce food losses by 50 per cent by 1985 as was agreed to by the United Nations General Assembly.

### Institutional arrangements for extension services

Extension services in agriculture in Africa are inadequate and the extension workers are generally too ill-equipped and poorly paid, and thus unable to spread technological innovations among farmers. Most countries spend comparatively little on agricultural training and extension services.<sup>21/</sup> Improved and comprehensive policies on agricultural extension services as one of the means of improving the food situation are emphasized in the Lagos Plan of Action. At the national level the training and remuneration of extension agents are also to be accorded high priority.

Most of the farmers in Africa use farming practices that are not conducive to increased production. For example, the majority of farmers still use the simple hoe, unimproved seeds, little fertilizer, little or no irrigation. Consequently, yield is stagnant and outputs are low; even though they toil very hard they fail to really improve their condition. Policies to design simple implements to enhance production should be pursued. This calls for research for improved technology and improved farming systems that are appropriate to African conditions without having to displace too many farm labourers too soon or cause widespread unemployment.

### Land tenure systems

The World Conference on Agrarian Reform and Rural Development (WCARRD) held in Rome in 1978 confirmed unequivocally that some land tenure systems in Africa are not conducive to increased food production. In some cases the beneficiaries of the land tenure systems have been very few rich people, some of whom are absentee landlords. Traditional land tenure systems in some countries, e.g., Zaire, have made it difficult for farmers to move outside the tribal land holding systems. Policies for reform of land tenure systems to benefit the majority of the population should be undertaken by all Governments as contained in the WCARRD Plan of Action and follow-up. Some countries, such as Ethiopia, have started land tenure reform programmes to benefit the



majority of the farming population. In Burundi and Comoros, efforts to change traditional land practices have met with little success because of certain traditional practices and organizational complexities, as well as resistance from farmers.22/

### Inadequate infrastructure in the rural areas

Increased food production cannot be achieved without the necessary and overdue improvement of the rural life and infrastructure. Rural road networks and transportation to facilitate marketing of inputs and farm produce, improvement in housing and health services, education, and so forth, are essential investment projects without which food and agricultural improvement and the development of human resources in most African countries cannot be achieved. The need to improve the health of the teeming millions of Africans in rural areas cannot be overemphasized. But this can only be achieved if greater concern is shown in rural development.

### Promotion of substitutes for imported foods and dietary education

Some of the foods that Africa imports, e.g., wheat, are those for which Africa has little or no comparative advantage in their production. Hence Governments need to educate consumers and adopt policies which would enable the population to eat more of locally produced commodities. In the case of bread and other flour-products for example, composite flours have been developed incorporating millet, sorghum and cassava flours. In Senegal, the production and marketing of a 30 per cent millet and 70 per cent wheat flour bread has been carried out with some success.23/ It has also been suggested that the evolution of a technology package to convert more of locally produced food into convenience foods, in well packaged, storable and easily cooked forms will enhance this substitution effort, thereby reducing Africa's reliance on food imports and food aid.

### Improvements in livestock and fisheries production

Governments should take steps to assist and encourage farmers to improve their livestock husbandry and maintenance. The rearing of livestock such as goats, pigs, sheep, cattle and poultry through improved extension services and control of diseases will surely improve the output of meat, milk and eggs to feed Africa's growing population. Many countries in Africa have the potential for fish production. To increase domestic fish production, Governments should implement effective fisheries projects by making available facilities for improved and better fishing, through the provision of modern fishing vessels, better processing facilities, improved storage facilities and marketing network, and better prices.



### Demographic measures

The demographic problems facing Africa are very serious and complicated indeed; involving as it were several interrelated social, economic and political parameters. Food shortages, unemployment, inadequate rural facilities for education, health and housing are only some of the many socio-economic problems requiring urgent solutions. Rapid population growth compounds these problems and highlights the fact that time is running out. At present nearly all African countries import foodstuffs, especially cereals. One of the several policy measures emphasized in the Lagos Plan of Action for tackling the economic problems is the need for co-operation, both technical and economic, among member States through joint programming, harmonized policies, and increased trading among themselves at regional and subregional levels.

In the wake of a strong political will and a sense of self-determination, African countries can resolve these problems, provided they adopt and implement realistic economic development policies as spelled out in the FAO Regional Food Plan for Africa and the Lagos Plan of Action. These should correctly include population policies which will in the long run complement food, agriculture and economic development strategies. In this context, resolution IX of the 1974 World Food Conference on the achievement of a desirable balance between population and food supply is pertinent. This resolution called on "all Governments and people everywhere not only to make every possible effort to grow and equitably distribute sufficient food and income so that all human beings may have an adequate diet, but also support, rational population policies ensuring to couples the right to determine the number and spacing of births, freely and responsibly, in accordance with national needs within the context of an overall development strategy".<sup>24/</sup> Policies to monitor rural to urban migration should also be adopted and implemented in an effort to boost food production. Finally, while it is acceptable that African Governments must take the responsibility to solve their own problems, it should be pointed out that Africa will still need external assistance from developed countries.

### Summary

This paper has in broad terms identified, analysed and discussed the food problem in Africa, calling attention to the critical gap between supply and demand and warning that the situation is getting worse. The consequences of inadequate food production on dietary and nutritional requirements have also been discussed. The exposé identified the factors determining demand for food and supply and indicated that population growth contributes more than 70 per cent to food demand. It is apparent therefore that continued population growth without a substantial increase in food production makes the task of improving the food situation in Africa very difficult indeed. Problems of rural to urban migration also contribute to food production by attracting able-bodied people away from rural areas where they are seriously needed in food production. Instead, they go to the cities where they add to the demand for food in urban areas.



It should be noted that population growth should not be looked at from the negative point of view only. It should also be considered from the positive aspect of contributing to food production and economic development in general. However, in many African countries where the majority of the population depends on agriculture, the increase in the agricultural labour force has not necessarily increased food and agricultural production. Instead, it has created underemployment or serious unemployment problems. This being the situation, the most feasible strategy is that the food production problems should be solved through progress in overall food and agricultural development which will simultaneously generate increased employment opportunities and lower rates of population growth. However, lowering population growth per se is not a sufficient or essential condition for improving the food and nutrition problems; nevertheless, rapid population growth makes the job more difficult and intractable in some cases.

Furthermore, specific policies and measures needed to improve the food situation in Africa have been presented. These relate to the pricing of farm produce and inputs, the expansion of cultivated land, policy priority to food crops instead of cash crops only, the reduction of post-harvest food losses, an improvement in institutional arrangements for extension services, improving farming husbandry, technology and skill, rationalizing the land tenure systems, the promotion of substitutes for food imports, an improvement in livestock and fisheries production, regional and subregional co-operation and trade in food and agricultural products among African countries and the control of population growth and urbanization. If Governments do not take any realistic and pragmatic actions as suggested, the situation given in the trend projections for production and demand for food by 1990 is likely to happen. This implies a worsening situation in the food situation in Africa.

Finally, it must be mentioned that the relationship between population and food production is far from being static; it is a dynamic element and an inevitable key factor in both human and economic development of any country. For Africa the task is tremendous but given the perceived strong political will and courage manifested in the Lagos Plan of Action, appropriate policy measures can be evolved which can bring significant results, implemented through the process of effective investment strategies for food and human population development in all countries of Africa.

#### Notes

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## D. Population, resources and development

United Nations\*

### Introduction

The frailty of the balance between population and resources is a basic concern of the Food and Agriculture Organization of the United Nations (FAO). The purpose of FAO is to promote agricultural and rural development and to contribute to the improvement of people's nutritional level.

The fragile natural conditions that exist in certain countries and the lack of agricultural inputs, including technology, that prevails in many, severely limit the potential for agricultural and rural development. In the first section of this paper the physiological limits of land to support human populations are broadly delineated for countries according to pressure on resources. The challenge that world agriculture faces in accommodating population and economic growth to the end of the century was analyzed under alternative strategies in FAO, Agriculture: Toward 2000.1/ The second section takes off from that study to examine the impact which an abatement of population growth could have by the year 2000 on resources in general and on the performance of the agricultural sector of developing countries in particular. High performance of agriculture relative to the level of population pressure is a necessary but not a sufficient condition for improving people's nutrition. The poverty of individuals, unable to produce or to buy their food, can offset the gains from agricultural growth and lead to increases in the numbers of undernourished. The purpose of the third section is to link poverty to malnutrition. The final section deals with one specific aspect of the relation between distribution and undernutrition. Intuition alone suffices to suggest that should the incomes of the poor increase through redistribution the incidence of hunger will decline. Little attention, on the other hand, has been paid to the symmetrical proposition that rapid increases in the incomes of the non-poor might also contribute to increasing the numbers of undernourished. The purpose of the final section is to highlight certain issues of the "food-feed competition" which deserve further attention in the future.

### Population pressure on resources: supporting capacities of lands

It is not surprising that the estimates that have been made of cultivable land and of its capacity to support human populations have yielded greatly varying results. The definition of arable land crucially depends upon the level of technology, the levels of input-use in agriculture and the specific output mix. The supporting capacity of a land area, on the other hand, depends on the nutritional intake of a human population, on the form in which it is consumed and possibly on various other institutional and socio-economic factors. Finally the level of aggregation at which supporting capacity is considered can make a vast difference in the answers received.

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\* Food and Agriculture Organization of the United Nations. The views and opinions expressed in this paper do not necessarily reflect those of the FAO governing bodies and may not be shared by some of the FAO member countries.



The significant characteristics of the FAO work on "potential population supporting capacity of lands" (hereafter referred to as carrying capacity project) are the improved soil and climatic data from which it starts; and the explicit specification of the assumptions made about technology, inputs and nutritional intake requirements. By superimposing a climatic inventory of a region on its soil maps, an inventory of the length of the growing period/soil of different lands is obtained.<sup>2/</sup> Next the crop-growing potentials and yields of each inventoried land unit are evaluated by matching the requirements of each of 18 most important crops with land attributes. Thus the food production potential of lands is obtained, expressed in calories. Next the physical food production potential of lands is converted into estimates of population carrying capacity. For that purpose the standard per capita nutrition requirement for daily calories is applied for each country. Last, the existing population is compared to the supporting capacity of the land in order to determine food-deficit and food-surplus areas.

#### The meaning and measurement of supporting capacity

Both sides that enter the calculations of the population-supporting capacity of lands - the "supply" side and the "demand" side - were derived under three assumptions. There are three distinct levels of inputs/technology.<sup>3/</sup> All cultivable land is devoted to foodcrops for final use (on the supply side) and all populations are fed at their "standard" per capita nutrition requirement (on the demand side). Such assumptions compensate for their simplicity by providing a strong standard against which actual situations can be gauged. The resulting index of supporting capacity (the ratio of supporting capacity to population) is an index of pressure on resources. As such it does not intend to indicate the "optimum" pressure but merely to set the upper limits of the capacity of land to support human populations. Within this framework, the simplifying assumptions involved should not impair the usefulness of the resulting index, in the same way as the abstraction of the idea of zero temperature does not render the thermometer useless.

The results of the supporting capacity study are presented at several levels of aggregation, which correspond to the entire continuum of the application of the assumption that population follows food and the converse. As a first approximation, the results are presented for the developing world as a whole and separately at the regional level - South America, Central America, Africa, Southwestern Asia and Southeastern Asia. This approximation allows for unrestricted movement within each region of the developing world of surplus food production potential and/or population. The results, shown in figure I, contrast the actual payload for each region with the potential supporting capacity payload, both expressed as persons per hectare and shown for the years 1975 and 2000. The three levels of inputs/technology distinguished are shown separately.

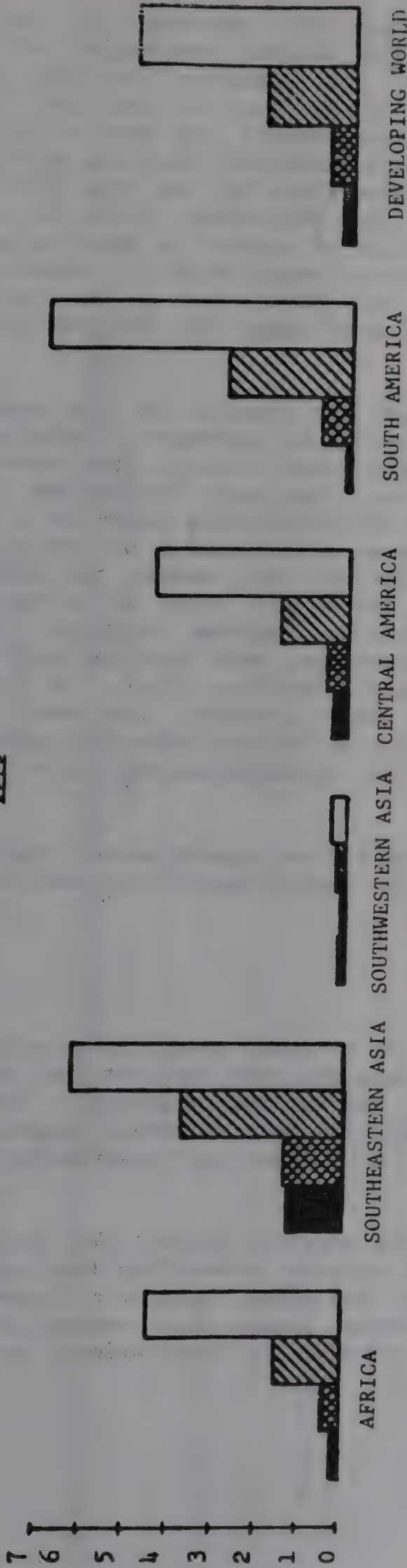
Figure I indicates that Southwestern Asia is a "critical" region for the developing world. The 1975 density of population of 0.20 persons per hectare exceeds the potential population carrying capacity of 0.16 persons per hectare at the low input/technology level. Barring interregional net imports, at



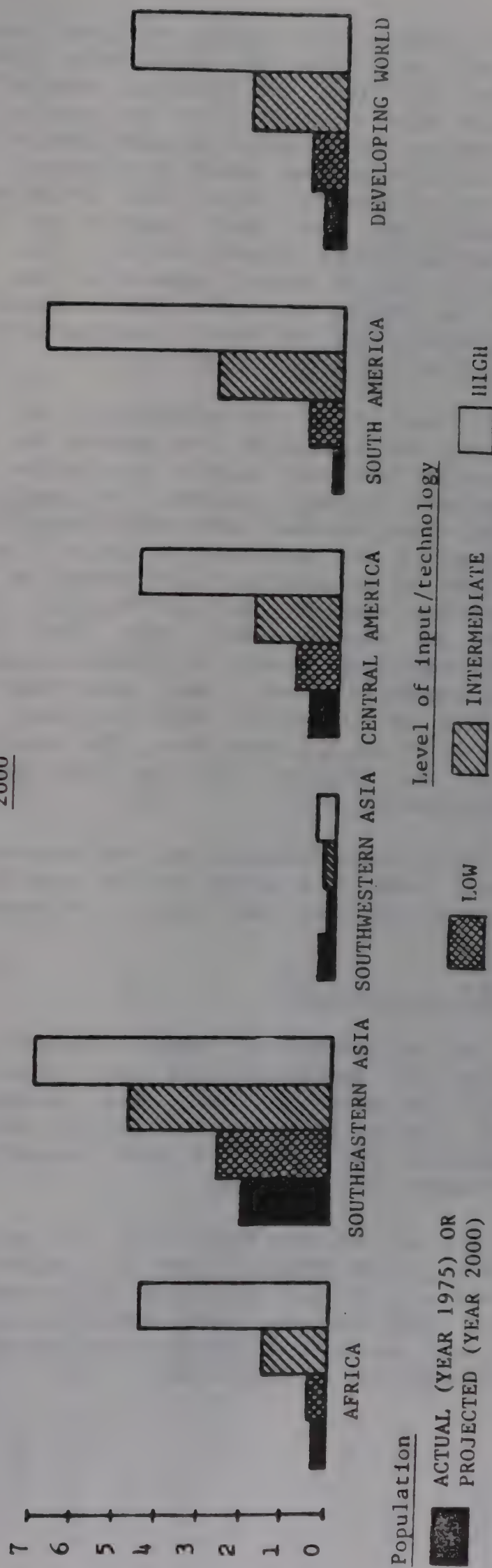
Figure I.

Actual payload of population and potential population-supporting capacities in five regions of the developing world, 1975 and 2000  
(persons per hectare)

1975



2000



Population

ACTUAL (YEAR 1975) OR  
PROJECTED (YEAR 2000)

Level of input/technology

LOW INTERMEDIATE HIGH



least intermediate levels of input/technology were necessary to carry the region's population in 1975, even under the extreme assumption of having devoted all land to foodcrop production. The situation for this region becomes more critical with the population projections of year 2000 (medium alternative, 1978 United Nations population assessment). By then a high level of inputs/technology would be required if the potential carrying capacity of the region were to exceed the projected population in the year 2000. The situation for the other regions and for the developing world as a whole (excluding China) is much better. The "margin of safety" by which supporting capacity exceeds actual population per hectare ranges from 1.1 (Southeastern Asia in 1975) to 6.0 (South America in 1975) for a low level of input/technology and has a considerably broader range for the year 2000 and for better input/technology use.

A lower level of aggregation at which the results of the supporting capacity are presented presupposes the unrestricted movement of surplus food production potential and/or population within each country. The standard of comparison becomes national self-sufficiency for each developing country rather than regional self-sufficiency for the developing world as a whole. The results are presented in table 1 in terms of the number of countries and millions of population that become in deficit, i.e., exceed the countries' supporting capacity in each region. If the safety valve of intraregional trade is closed, the year 2000 situation becomes critical at low input/technology levels in 65 developing countries, more than one half of the total number studied. Even under high input/technology levels, 19 countries continue to remain in deficit; many of these, however, are small island territories or oil exporters. The population of deficit countries ranges from 47 to 441 million for the high and low input/technology alternatives, respectively.

While these findings are the results of a first approximation study, they clearly identify a major problem area in the complex population/food equation - namely national land resource endowment.

### Policy implications

The achievement of remedial measures, in critical areas, will undoubtedly involve the application of many social, economic and institutional policies within the context of all human, national and material resources. The study makes a start at quantification of the physical land potential component and emphasizes the need for this essential data base for considering viable development alternatives.

The use of the results of the carrying capacity project for formulating precise policy prescriptions is limited by certain assumptions that were made as well as by the objective of producing rank-order indexes of pressure on land. Nevertheless, some unmistakable broad trends that emerge from the analysis can lead to policy conclusions relating to international trade, to technology and to migration.



Table 1. Number of countries and their populations which will exceed supporting capacity in the year 2000, by level of input/technology

Deficit situations	Africa	Southeastern Asia	Southwestern Asia	Central America	South America	Total
<u>Countries (number)</u>						
Total	51	16	15	21	13	117
of which deficit at input/technology levels:						
Low	30	6	15	14	0	65
Intermediate	12	2	15	7	0	37
High	4	1	12	2	0	19
<u>Population (million)</u>						
Total	828.5	1937.1	264.7	215.2	392.2	3638.1
of which in excess of carrying capacity at input/technology levels:						
Low	200.9	70.7	107.6	18.0	0	447.2
Intermediate	43.3	7.7	78.5	6.9	0	136.4
High	1.8	3.1	41.9	0.5	0	47.3
<u>Land area (million hectares)</u>						
Total	2,878.1	897.6	677.4	271.6	1,770.2	6,494.9



A stark contrast exists between figure I, which reveals almost no deficit situations, and table 1, which reveals the widespread inability of some countries to live within the bounds of their supporting capacities. The difference is accounted for by interregional trade. Southeastern Asia, for example, which has a safe margin of excess supporting capacities at the interregional trade level, turns out to have 6 out of its 16 countries in deficit if net imports are ruled out. Africa is an even more striking case. Although the continent has a comfortable margin of excess capacity under all technological alternatives, in the year 2000, 30 out of its 51 countries will be in deficit and almost one third of its total population in excess of the capacity of the land. The implication is that the remaining 21 countries are responsible for the surplus capacity at the regional level.

Both figure I and table 1 refer exclusively to developing countries. Should the developed countries also be included in the trade framework, the excess of supporting capacity at the world level of aggregation will be much amplified. In fact, given the distribution and growth of both population and resources, it is likely that the real margin of safety for food requirements lies with the countries not included in the analysis, the developed countries, which are already using high levels of input/technology.

When the picture of the safety margin for human nutrition is examined at the country level (table 1), the role of input/technology becomes evident. The population in excess of carrying capacities increases tenfold, to 440 million as one goes from high to low input/technology. The real reserve potential lies not so much in idle land, but in raising technology levels.

By changing the supporting capacity of lands, technology appears to be the major factor determining the dynamics of human settlements. The huge rural-to-urban migratory movements, which have become a primary feature of the development experience of the last quarter century, are to a large extent correlates of the "transportation revolution" which made it possible to deliver food at low cost to massive concentrations of population. In other words the new transportation technology, the internal combustion engine with a huge infrastructure in rail, road, water and airways, increased the supporting capacity of the land of urban centres to accommodate unprecedented rural-to-urban migration movements.

Quantum technological change applied on the agriculturally unutilized land reserves of the world could increase the carrying capacity of land and provide the springboard for a new rural-to-rural migration movement. The described project, by determining supporting capacity at alternative assumptions of input/technology, can provide an indication of the agro-ecological zones which may become the poles of rural-to-rural migration in the future.

Table 2, for example, classifies the land of three countries and of all of Africa according to length-of-growing period. An interesting feature of the table is the high ratio of potential-to-present population (as indicated by the high values of the supporting capacity index) that exists at the upper end of the range of periods. Most of the remaining agriculturally unutilized land reserves of the world are in this ecological zone which comprises the high rainfall tropics where natural vegetation is high climax forest. Despite the



Table 2. Present population and potential population-supporting capacities, by length of growing period, Africa

Length of growing period (days)	Country A			Country B			Country C			Total Africa			
	S-C a/ index	Density b/ Actual Potential	Total Land (%)	S-C a/ index	Density b/ Actual Potential	Total Land (%)	S-C a/ index	Density b/ Actual Potential	Total Land (%)	S-C a/ index	Density b/ Actual Potential	Total Land (%)	
Warm Tropics													
330-365				15.45	0.08	1.21	1.95	0.29	1.69	58.38	0.26	1.62	11.02
300-329				1.88	0.65	1.22	1.09	0.15	0.80	8.23	0.23	1.47	3.63
270-299				2.29	0.36	0.82	25.43	0.14	0.63	14.81	0.23	0.91	6.32
240-269	2.21	0.25	0.56	0.76	0.87	0.66	20.00	0.10	0.68	14.83	0.19	0.89	6.61
210-239	1.75	0.26	0.45	1.59	0.35	0.56	20.28	0.10	0.69	3.12	0.16	0.64	0.98
180-209	1.98	0.25	0.48	1.09	0.38	0.41	13.25	0.13	0.78	0.63	0.16	0.47	11.18
150-179	1.51	0.28	0.42	0.28	1.11	0.32	6.81				0.17	0.47	8.66
120-149	1.00	0.22	0.22	0.43	0.41	0.18	6.71				0.22	0.15	5.65
90-119	1.07	0.22	0.24	0.44	0.24	0.10	4.07				0.18	0.10	3.56
75- 89	0.75	0.22	0.17	...c/	...c/	0.01	0.41				0.13	0.06	2.89
1- 74	0.09	0.16	0.02								0.07	0.03	18.30
0	0.01	0.17	0.00								0.01	0.00	8.95
Average	0.68	0.19	0.13 (100.00)	1.15	0.51	0.58 (100.00)	5.84	0.22	1.27 (100.00)		0.15	0.50	(100.00)
Cool tropics													
330-365	0.14	0.28	0.04	0.05	0.82	0.04	9.31	0.14	0.02	47.72	0.36	0.03	4.74
300-329	0.42	0.28	0.12	0.61	0.20	0.12	1.25	0.12	0.10	13.46	0.48	0.13	3.36
270-299	1.19	0.19	0.23	0.32	0.53	0.17	4.65	0.12	0.08	14.83	0.44	0.17	11.48
240-269	0.67	0.36	0.24	0.02	1.14	0.02	7.83				0.59	0.27	16.63
210-239	0.73	0.35	0.26	0.01	3.77	0.02	8.06	0.07	0.25	23.99	0.90	0.27	15.08
180-209	0.83	0.28	0.23	0.07	2.04	0.15	10.33				0.84	0.23	13.81
150-179	0.76	0.29	0.22	0.14	1.32	0.18	35.07				0.59	0.23	6.63
120-149	0.43	0.22	0.10	0.13	0.81	0.10	11.81				0.46	0.14	6.10
90-119	0.07	0.23	0.02	0.05	0.30	0.01	8.51				0.10	0.02	7.41
75- 89	0.07	0.32	0.02	...c/	...c/	0.01	3.18				0.08	0.02	4.01
1- 74	0.03	0.19	0.01	...c/	...c/	0.01					0.28	0.05	2.30
0											...	0.04	4.28
Average	0.65	0.28	0.18 (100.00)	0.08	1.29	0.11 (100.00)	0.82	0.12	0.10 (100.00)		0.32	0.17	(100.00)
Average	0.62	0.23	0.14	0.99	0.56	0.55	5.78	0.22	1.25		0.14	0.39	

a/ Supporting capacity (S-C index) is defined as potential divided by present population.

b/ Density is expressed in terms of present (actual) population or potential population divided by area (hectares).

c/ Indicates present population zero.



substantial variation within this zone with respect to soil suitability for permanent cultivation, most lands, if well managed, could provide attractive levels of production. The year-round opportunities for growth provided by adequate temperatures and moisture are the basis for the high production potential. Correspondingly, these areas have generally high potential population density per hectare as compared with the actual density, while the middle-range, savannah-type lands currently have populations close to their potential density.

These lands, of course, are not problem-free and if they are to become important migration poles in the future many obstacles will have to be overcome by the intensive application of technological and managerial inputs. New institutional approaches would also be required in order to develop the economically and socially effective organizational forms that support rural-to-rural migration. Mounting population pressure may well provide the catalyst for such changes. If so, a Boserup scenario develops in which population growth is the exogenous variable that induces technological change altering the carrying capacity of lands and thus extending the rural-to-rural migration movement.<sup>4/</sup>

Population pressure on resources: performance  
of agriculture to the year 2000

In its role of monitoring the world food situation, the FAO engages in periodic evaluations of the record of agriculture and in projections of the observed trends into the future. When the continuation of latent trends appears untenable it becomes especially important to stop and take stock and to present clearly defined policy alternatives. Such was the situation in the late 1970s. It gave occasion for the assessment of world food and agriculture prospects in the study Agriculture: Toward 2000.

Beginning in the mid-1960s and for the next 15 years (1966-1980) agricultural production in 90 developing countries grew at a healthy 3.0 per cent per year thus exceeding the 2.5 per cent annual growth rate of the population of the developing world.<sup>5/</sup> Per capita incomes also grew in the same period, roughly doubling in 15 years. As a result apparent consumption of agricultural products grew faster than production, at an annual rate of 3.3 per cent. The difference was fueled by rapidly increasing food and agricultural imports. Developing countries increased their agricultural imports at a rate of 6.8 per cent per year, as compared with a 2.9 per cent increase in their exports. The result was a deteriorating balance of agricultural trade.

Neither progress nor retrogression was uniform. In no fewer than one half of the 90 countries, growth in agriculture failed to keep up with population growth. In the group of the poorer (low-income) developing countries production growth at 2.5 per cent barely kept up with population growth of 2.4 per cent per year. Africa as a whole, in particular, registered the highest (and increasing) population growth rates in combination with rapidly falling per capita production.



Extrapolation of the present trends into the next 20 years produces some untenable results. Even with appropriate bounds to the trend projections it is not surprising to find that the problems of certain countries would be magnified by the year 2000. For example, the group of the low-income countries with two thirds of the 90-country population would continue to have low per capita calorie supplies of about 2,170 (compared with 2,080 in 1980), while the middle-income countries could reach a respectable level of 2,700 calories. Moreover, the low-income countries would have to increase their net cereal imports from the developed countries in order to achieve even this meagre improvement. Net imports of cereals would increase sevenfold, while the trade balance that represented 6 per cent of total production in 1966-1968 would amount to 21 per cent of developing countries' cereal production in the year 2000. Under these circumstances the number of people with inadequate nutritional levels (undernourished) could increase further in the 90 developing countries of the study, from 435 million in the mid-1970s to some 600 million. Indeed continuation of present trends brings outcomes which are definitely alarming. This is not so much because the developing countries as a whole are shown to continue on a slow path of change, but rather because a continuation of trends would hit hardest the most populous and poorest developing countries, condemning many of them to stagnation, or worse, to deteriorating living standards.

#### An alternative future

The study, Agriculture: Toward 2000, maps out alternative scenarios for the development of the world's food and agriculture up to the end of the century. Given the projections of population and the projections of GDP growth in the International Development Strategy, the demand for agricultural output is estimated, for each developing country, commodity by commodity (90 countries, China excluded and 28 commodities). Given the demand projections, feasible rates of growth of production are worked out, again at the level of country and commodity disaggregation, based on the objective of improving agricultural self-sufficiency and subject to country-specific natural, institutional and organizational constraints.

The model of Agriculture: Toward 2000 can accommodate alternative assumptions with regard to a number of variables that move the world food economy. The impact of certain changes in assumptions mainly on population and income growth will be illustrated here.

The United Nations projections for the year 2000 are slightly lower in the 1980 assessment than in the 1978 assessment: 1.6 per cent for the world as a whole, and 2.2 per cent for the developing countries (excluding China) as compared to 1.7 and 2.4 per cent per year, respectively (medium variant).<sup>6/</sup>

Two different states of world population can be described by comparing the medium with the low United Nations population variant. The effect of adopting the latter (1980 assessment) is that world population in the year 2000 would be lower by 282 million (or 4.6 per cent), down from 6,119 to 5,837 million. The population in the 90 developing countries would be lower by 201 million (or 5.8 per cent), from 3,477 to 3,276 million. These differences become more



significant at the regional level: population in Africa in the year 2000 would be 87 million (or 12.6 per cent) lower than under the medium variant. In fact one third of the 90 countries (of which 28 countries in Africa alone) would have population reductions of more than 10 per cent.

How would the two different states of world population reflect on the system of the world food economy? One set of assumptions that can be readily incorporated in Agriculture: Toward 2000 would have population growth differentials trigger changes in demand and, to a lesser extent, in production. Change in demand will be largely dependent upon what happens to per capita incomes following different rates of growth of population. A priori theorizing about the relationship between population and income growth rates is rather weak. A convenient assumption (which is consistent with the income projections of the International Development Strategy that aim at narrowing the gap between the rich and the poor by the year 2000) would be to consider per capita incomes remaining unchanged under both population projection variants. That would imply for the low variant a reduction in the rate of growth of GDP, and a roughly proportional reduction in total demand.

Production can change as labour force changes following alternative population projections. This effect on production can be safely assumed away in a 20-year modelling exercise since the addition to the labour force from people born after 1980 will be rather small. A more significant adjustment in production is likely to reflect the lower domestic (and possibly also export) demand that follows lower population growth rates. Alternative assumptions can be made on how changes in demand are transmitted to production levels in a system that is open to world trade. In this specific case certain trade balances are considered as constraints and the logic of production adjustments is based on a measure of population pressure on resources.

#### Agriculture towards 2000 with low population pressure

Developing countries can be viewed as striving to achieve (but not always succeeding) a certain self-sufficiency ratio in agriculture, for a number of conceivable reasons, including "food security" considerations and foreign exchange limitations. Above 100 per cent self-sufficiency, countries become net exporters of agricultural commodities; otherwise, they are net importers. Should population growth abate, countries could respond with lower agricultural production subject to limitations of international trade. If population in 2000, for example, is lower than the "reference projection", an importing country could not, by the fact of lower demand, become an agricultural exporter if export markets are saturated. The "reference" export surpluses, in other words, should not be exceeded lest international trade does not balance. Notwithstanding the sometimes strong dampening effects of these constraints imposed by the market, within these trade bounds, countries have a certain latitude in adjusting their production to cover the projected slowdown in the rate of growth of demand - reflecting population growth lower than the "reference" rate.

Ex hypothesi, the adjustment of production can be linked to the resource constraints of a country. The more limited the agricultural resources in a



country are, the greater the strain of meeting the agricultural self-sufficiency requirements of a growing population. For such countries a decrease in population growth may offer the opportunity to relieve pressure from agriculture by lowering the target for agricultural output on a scale close to the decline in demand.<sup>7/</sup> At the opposite extreme, countries with ample resource endowments are likely to maintain their production levels, in which case a lower domestic demand would mean an improvement in the agricultural trade balance with an ensuing release of foreign exchange (through lower import demand or increased exports). An operational criterion can be formulated which distinguishes among alternatives of production behaviour based on the severity of resource constraints.

The resource constraints that can be readily measured in Agriculture: Toward 2000 refer to the three main sources of agricultural output (i.e.,  $\text{production} = \text{arable land} \times \text{cropping intensity} \times \text{yield}$ ). One might consider "arable land" as a proxy for the physical resources available to agriculture and look upon "yield" and "cropping intensity" as proxies for the technological and managerial resources. Moreover, based on these sources of growth, an index can be constructed to measure pressure on resources. The index involves the actual levels of resource utilization that existed in 1975 with respect to arable land, yields and cropping intensity, on the one hand and also to the "potential" levels of resource utilization as identified for each country for the year 2000. The ratio of the two, actual 1975 over potential 2000, gives an index of pressure for each individual resource, and the combination of the indexes of arable land, yields and cropping intensity yields a total index of resource scarcity. Once the scarcity index of a country has been calculated, the elasticity of production with respect to demand is set at the square of the scarcity index. Given the change in demand and the elasticity, the response of production to population declines is readily determined, always subject to the constraints on the international trade balance.<sup>8/</sup>

Countries were classified according to the value of the indexes of pressure on resources as follows: index of 0-40, low scarcity; 40-70, medium scarcity; 70-90, high scarcity; and 90-100, very high scarcity. Table 3 indicates that although many countries are running out of land, the combination of increasing yields and cropping intensity still offers a considerable margin of safety. Almost all countries of the Far East and Near East are marked by high scarcity, with respect to land especially (10 out of 15 and 12 out of 14 with very high land scarcity) but also to a lesser degree with respect to total resources. The Latin American countries, on the other hand, followed by the countries of Africa, still have relatively ample land resources and generally low indexes of total resource scarcity.

The main results of the evaluation for total agriculture are given in table 4. For easy reference the results are compared with the historical experience of the period 1966-1980. The medium population projection for the year 2000 implies an annual rate of growth in agricultural demand slightly above the rate registered in the period 1966-1980, although this is not true for all regions. The low population scenario, on the other hand, dampens the rates of growth in demand to levels below the historical period, with the exception of Africa. The feasible rates of production that correspond to the



Table 3. Pressure on resources: classification of countries by regions into resource scarcity classes

	Number of countries	Total resources index			Number of countries	Arable land index		
		AF	FE	LA		AF	FE	LA
Low scarcity	9	6	-	3	-	9	-	10
Medium scarcity	33	17	2	12	2	2	2	4
High scarcity	45	14	11	9	11	8	3	6
Very high scarcity	3	-	2	-	1	18	10	4
Number of countries	90	37	15	24	14	37	15	24

a/ AF = Africa; FE = Far East; LA = Latin America; NE = Near East.



Table 4. Growth rates of population, demand and production; self-sufficiency ratios for total agriculture; observed and projections to 2020 for medium and low population scenario (Percentage)

	1966-1980		1978-1980 Self-sufficiency	Population projections 1980		Scenario projections 1978-1980 to 2000		Self-sufficiency	
	(population)	(demand)	(production)	assessment (medium)	assessment (medium) (low)	Demand (medium) (low)	Production (medium) (low)	(medium)	(low)
90 developing countries	2.5	3.3	3.0	2.4	2.2	3.4	3.1	3.2	105.5
Africa	2.9	3.0	1.7	3.0	3.1	4.3	3.7	3.8	102.2
Far East	2.3	3.1	3.2	2.1	1.9	3.0	2.8	3.0	104.5
Latin America	2.6	3.3	3.1	2.6	2.2	3.4	3.2	3.4	117.7
Middle East	2.7	4.4	3.2	2.6	2.6	3.3	3.1	3.3	88.6
(Low income)	2.3	(2.7)	(2.5)	2.3	(2.1)	(3.3)	(3.0)	(3.2)	(102.9)
(Middle income)	2.7	(3.8)	(3.4)	2.6	(2.5)	(3.4)	(3.2)	(3.3)	(107.9)
Other developing countries (including China)	1.8	3.5	3.3						
All developing countries	2.2	3.4	3.1	100.4					
Developed countries (Market economies)	0.8	1.7	2.0	99.8					
(Centrally planned economies)	0.8	1.5	2.1	102.4					
	0.9	(2.1)	(1.7)	(94.8)					

Note: All past growth rates are derived from statistically fitted exponential trend equations. Future growth rates are measured from the actual data for the average 1978-1980.



two demand projections are almost universally above the rates observed in 1966-1980. More specifically, in comparing the medium with the low population scenario, an overall decline in the population growth rate from an annual rate of 2.2 to 1.9 per cent to the end of the century would lead to a decline in demand from 3.4 to 3.1 per cent per year and a smaller decrease in production, from 3.5 to 3.2 per cent. Correspondingly, the self-sufficiency ratio of all developing countries as a group rises slightly from 104.5 to 105.5. These results are more pronounced for Africa, where a 0.6 reduction in demand growth (from 4.3 to 3.7 per cent) would be followed by a 0.4 decrease in production growth (from 4.2 to 3.8 per cent), raising the overall self-sufficiency from 97.6 to 102.2 and thus turning the agricultural trade balance positive.

Table 5 presents the results of the medium and low population scenarios in groups of countries according to their scarcity indexes. Finally, table 6 breaks down the growth of agricultural output to the year 2000 into three components: the contribution of the increase in arable land, yields and cropping intensity, again by scarcity classification. Examination of the table reveals that yield increases will predominate among the sources of growth in the next 20 years, in most cases accounting for one half or more of the additional output. Individual country situations can differ widely. While in Egypt only 2 per cent of production growth is based on arable land expansion, in Brazil land extension accounts for 74 per cent of output growth.

### Conclusions and policy implications

The model Agriculture: Toward 2000 was run with alternative population assumptions for the purpose of illustrating the impact of a lower population growth rate (United Nations assessment 1980, low variant) on the world food economy in the year 2000. Agriculture in the developing countries would have to grow at historically unprecedented levels (from 3.3 to 3.5 per cent per year, depending on population assumptions) to meet the challenge of population and income growth by the end of the century. With substantial input commitment such growth rates are feasible. With more moderate population growth, however, a considerable margin of safety is achieved when it comes to the mobilization of resources for agricultural growth. Such a safety margin is probably necessary for a sector that otherwise needs to perform consistently at top capacity and produce at historically unprecedented levels, despite the periodic vagaries imposed by weather or human institutions. More specifically, the situation of world agriculture in the year 2000 with reference to medium and low population levels can be summarized as follows:

(a) The deceleration in population growth between the medium and low United Nations variant (1980 assessment), referring to 90 developing countries, amounts to a population projection for the year 2000 that is 5.8 per cent lower than the medium variant projection. This population is still 1.0 billion, or 47 per cent higher than the base year 1980 population;

(b) The decrease in population pressure between the two variants results in a slight decrease in the rate of growth of demand from 3.4 to 3.1 per cent per year. Still, this slight change is significant since it brings the rates of growth in demand to levels below the historical period 1966-1980 (except for Africa);



Table 5. Population, demand, production and self-sufficiency ratios for countries grouped by scarcity index under medium and low population variants, projections to the year 2000

Country group	Number of countries	Percentage of total population	Growth rates, 1980-2000 (percentage)			Production (medium) (low)	Self-sufficiency ratios 2000 (medium) (low)
			Population (medium) (low)	Demand (medium) (low)	Production (medium) (low)		
<u>Overall scarcity</u>							
Low scarcity	9	3	2.9	2.3	4.6	4.1	94.4 101.3
Medium scarcity	33	22	2.7	2.2	3.8	3.5	112.3 114.9
High scarcity	45	71	2.1	1.9	3.2	3.0	103.2 103.4
Very high scarcity	3	4	1.9	1.7	2.5	2.3	85.1 85.1
<u>Land scarcity</u>							
Low scarcity	19	7	2.7	2.3	3.9	3.6	102.8 106.2
Medium scarcity	9	9	2.4	2.1	3.7	3.5	122.3 123.5
High scarcity	18	18	2.1	1.8	3.1	2.9	116.5 117.1
Very high scarcity	44	66	2.2	1.9	3.3	3.0	97.1 97.7



Table 6. Sources of growth of agricultural output, 1980-2000,  
by resource scarcity classes  
(Percentage)

[illegible]



(c) The corresponding deceleration in production growth rates is from 3.5 to 3.2 per cent per year. Either rate is higher than the 1966-1980 rate of 3.0 per cent. As a result the massive inflow of resources that world agriculture will require to the end of the century is only abated - not stemmed;

(d) Total arable land area in the 90 developing countries will still have to expand by 137 million hectares, as compared to 148 under the medium variant. Of this 39 million (as compared to 41 million) will have to be added to the existing 105 million hectares of irrigated land. Average cropping intensity will have to be raised to 85 per cent and average cereal yields to 1.83 tons per hectare (as compared to 86 per cent and 1.89 tons, respectively);

(e) Fertilizer requirements will still increase fourfold to 106 kilogrammes per hectare (as compared to 112 kilogrammes under the medium scenario). Total gross investment will increase threefold to a level of \$ US 117 billion (1975 dollars) per year as compared with \$ US 125 billion per year.

In conclusion, "the end of the population explosion" - if this is what is reflected in the low variant of the United Nations projections - should not foster any false hopes that the task ahead for world agriculture has become less difficult. It has only become slightly more manageable.

#### An evaluation of the undernutrition assessment

It is a safe analytical assumption to consider the undernourished as a subset of the poor.<sup>9/</sup> Both policy and measurement issues are considerably simplified in discussing undernutrition rather than poverty. The policy aspects of dealing with poverty have certain normative connotations that make measurement arbitrary. If society feels that people should not be permitted to die of exposure, then it will have to define the minimum shelter necessary to maintain life. If education is considered one of the basic needs, then the content of educational deprivation will have to be set with reference to a minimum standard of schooling. If "relative deprivation" becomes the content of poverty, then the "conditions" of deprivation (if not also the "feelings" of deprivation) have to be given an empirical counterpart. The concept of food-intake undernutrition, on the other hand, rests on biological underpinnings which make it less arbitrary. It commonly involves a critical limit of nutritional intake below which a person will almost certainly be undernourished. But this is where the simplification ends and the complication begins. Defining a "critical limit" implies that nutritional requirements can be determined unambiguously - an idea to which some take vigorous exception. Nutritional intake, which is a rather clear concept, turns out to be difficult to measure in empirically significant situations. It has become necessary, as a result, to develop a complicated methodology to get around the lack of data on the joint distribution of calorie intake and requirements.

The rather detailed description of the FAO approach to estimating the extent of undernutrition will serve to emphasize caveats of the operation and to suggest areas of improvement in methodology and in data collection.



### The approach

The 1973 joint FAO/WHO report defines for a population of "reference" men and women recommended daily energy intakes called "requirements".<sup>10/</sup> These are average requirements necessary to support moderate activity in the population of reference adults. The concept of such "fixed" energy requirements has been challenged; the pitfalls of the "average" requirements have been emphasized; and the usefulness of the construct for measuring undernutrition has been challenged. As some of the discussion rests on a misunderstanding of the FAO methodology, an attempt at clarification may be useful.

The variance around the norm of an "average requirement" has been extensively discussed in the literature.<sup>11/</sup> There is evidence that there is substantial variation in the intakes of individuals of the same age, sex and activity pattern even after adjusting for differences in body weight. Moreover, there is certainly variance which is socio-economic group-specific. The poor who are most likely to be undernourished may have different requirements than other groups. If poor families have higher fertility rates, the ratio of younger children to adults is higher and the group-specific nutritional requirement would be lower than the overall average requirement. This may be offset or over-compensated by the greater incidence among the poor of diseases which may impair calorie absorption. To the extent that the poor may have suffered from malnutrition in childhood, they have lower body weight and therefore lower total energy and weight-maintenance requirements. On the other hand, more pregnancies for the poor would require greater energy intakes. To the extent that the poor are more likely to be unemployed, they would require lower physical-activity-supporting energy. The opposite would be the case to the extent that they engage in more labour-intensive activities.

Even disregarding the inter-individual or inter-group variations in intakes, basing the estimation of the undernourished on the norm of average requirements produces an overestimate. If the distribution of reference individuals around the norm intake is normal, half of them would have intakes below the average and would thus be considered undernourished. "This is like determining whether a group of soldiers who cannot swim could cross a river safely by comparing their average height with the average depth of the river".<sup>12/</sup>

The method initiated by FAO first adjusts for some of the systematic components of the variance around the norm of the reference population - age/sex distribution and average body weight. The average requirement is thus derived country by country. It ranges for developing countries from 2,200 to 2,400 calories per capita per day. In contrast to some other studies which use that requirement as a cut-off point for undernutrition, FAO first steps down to a lower requirement that relates to minimum, rather than moderate activity.<sup>13/</sup> If the energy level necessary to maintain the body at rest is the basal metabolic rate (BMR), then 1.5 times BMR is assumed to be sufficient to maintain the vital functions of the body, to provide for the growth of children and adolescents, and to support certain minimal activity for adults. This level is roughly equivalent to 2,380 calories (for a male adult), and it



is assumed that an individual receiving an intake below this level cannot easily adjust by reducing activity. Thus, having no margin of safety, the individual will start losing weight. In this sense it is considered "at risk".

The BMR is itself an average and variation in individual BMRs around that mean still exists.<sup>14/</sup> It is assumed that the coefficient of variation is 0.10. Taking two standard deviations from the mean, the critical limit is set at 1.2 BMR, which is roughly 1,900 calories for an adult male. Persons below that critical limit are most likely to suffer from some form of energy deprivation since their calorie intake is not sufficient to allow for a healthy life with minimal physical activity.

Once the problems of defining calorie requirements have been solved, the actual calorie intakes have to be measured in order to estimate the number of those undernourished. Two problems arise because calories are not observed, commodities are observed, but data on actual commodity intake are rather scarce. The food balance sheets were used to derive the average calorie consumption in each country.<sup>15/</sup> It is assumed that this is also the mean of the distribution of calorie intake. Still the variance around this mean is needed in order to describe the entire distribution and thus to associate the critical calorie level (at 1.2 BMR) with a number of undernourished.

Even though there are no data available about the distribution of calorie intakes, there exists certain information about income distribution. Even better information has been accumulated about Engel's curves - the proportion of income spent on food, at times, even according to commodity classification. If one abstracts from habits, culture, relative prices and relative availability of commodities and services, one could go conceptually from income distributions and commodity distributions to calorie distributions and last to distributions of calorie intakes. If one assumes a relationship between per capita calorie intake and per capita income (or expenditure) one can obtain the standard deviation of calories from the coefficient of that relationship multiplied by the standard deviation of income.<sup>16/</sup> Next the entire distribution of calories can be defined. It has a lower limit, below which an individual cannot subsist (750-800 calories) and an upper limit, above which an individual cannot consume (4,500-5,000 calories). Knowing the lower and the upper limits of this distribution, its mean and its standard deviation, the proportion of population with calorie intake below the critical limit of 1.2 BMR can be estimated by using appropriate tables.<sup>17/</sup>

### Results and implications

The preceding methodological discussion demonstrates that an estimate of undernutrition is obtained by going a long and perilous way from distributions of income to nutritional requirements. Yet the issue is of sufficient importance to warrant the effort and the occasionally extreme assumptions. And besides, the results, with all the qualifications they may deserve, are probably quite reliable as compared with the results of measuring poverty, an issue that entails even more arbitrariness.



The most recent assessment of undernutrition was made by the FAO in connection with the study Agriculture: Toward 2000. The results appear in table 7. Although the extent of undernutrition is greatest in the regions with agricultural production short of demand requirements, the Near East and Latin America with supplies above their requirements also have over 10 per cent of their populations undernourished. It will be suggested in the following section that hunger is only partly an economic phenomenon involving production. It is more generally a social phenomenon, involving distribution and the competition of social classes.

The method followed for the estimation of undernutrition is admittedly imperfect and the validity of the results rests on the validity of certain crucial assumptions. In preparation for the Fifth World Food Survey an FAO/WHO expert consultation was convened in 1983 to re-examine the practical application of nutritional requirements. Still, the development of more adequate methodology which would address the criticisms that have been voiced against the current estimates would have to await the collection of first-hand data from the population of the undernourished. This in turn might have to wait until the often-expressed will to fight against malnutrition is matched by commensurate efforts to locate the undernourished population and to define the socio-economic profile of the victims in order to find remedies and not just provisional palliatives.

#### Poverty and hunger: where population ends and incomes begin

The unprecedented rate of population growth since the Second World War has often served as an explanation for deteriorating (or at least not improving) food balances and for the increasing incidence of undernutrition. While this causal link between population growth and food scarcity is correct, its overemphasis may have deflected the scrutiny that income growth deserves in explaining the world food situation. For income gains in the last two decades far outdistanced population increases. While population grew by about a half (44 per cent), per capita incomes roughly doubled between 1960 and 1980. Yet it is ironic that the world food problem is as grave today as it ever was, despite the fact that the world as a whole - most nations in general and most individuals in particular - is as well off today as ever before. To what extent is population alone, and/or poverty the principal cause of world hunger?

#### The food-feed controversy

In the majority of developing countries cereals are the major source of calorie intake for the poor. At a relatively low level of subsistence inadequate cereal consumption is synonymous with undernutrition. Cereals, coarse and often soft grains as well, are also used for animal feed, being converted to protein for human diets.<sup>18/</sup> "Chicken twice a week" is probably the first luxury that people in many countries acquire as they reach "middle-class" levels of income. The quantities involved are certainly substantial. In 1980, 550 million metric tons, which is 40 per cent of total cereals produced, went to animal feed. Can one make the case that if less cereals went to animals, more would go to people?



Table 7. Assessment of undernutrition in the developing world, by region, 1974-1976

Region	Number of persons (millions)	Percentage of population	Supply to require- ments ratio (percentage)
Africa	72	23	93
Far East	304	28	91
Middle East	19	11	104
Latin America	41	13	106
Total developing countries	436	23	95

Source: Food and Agriculture Organization of the United Nations, Agriculture: Toward 2000 (Rome, 1981), statistical appendix, table 7.

Note: The classification excludes the Asian centrally planned economies.



The question which sounds rather simple is both complicated and controversial. The great bulk of animal feed (72 per cent of the total) is used in the developed market and socialist economies. Even if it became available for direct human consumption, it is unclear that it would have found its way to the needy, it would have to be financed, to be transported and to be distributed. Moreover, the first likely outcome of reducing the feed use of cereals is that cereal production would fall because total demand would be less and prices would be lower. The main issue of inadequate cereal consumption by the poor is essentially one of insufficient incomes and demand.<sup>19/</sup>

The demand of developing countries for animal feed is certainly not insignificant, although the phenomenon is almost exclusively concentrated in the middle-income class of these countries. In the period 1966-1980 demand grew at 5.3 per cent per year - having started from low levels. This high rate of growth of cereal utilization for animal feed reflected more the rapid rate of growth of the middle-income classes and their appetites for animal protein, and less the overall rate of development in the developing countries. While curtailing the cereal use for animal feed in the developed countries may not help the problem of the poor, controlling the appetites of the middle-income class in the developing countries would probably have a salubrious effect. An increase in the price of cereals would decrease the demand for animal feed; but it would also increase the cost of subsistence to the poor; cheap food prices for the poor and for the urban consumers, on the other hand, result in subsidizing the indirect consumption of the middle-income class by diverting cereals to animal feed. It is suggested, on the other side of the controversy, that hunger is not being alleviated and periodic food crises do occur, not so much because incomes have been insufficient (they will always be) but mainly because middle-class incomes have grown so fast.

#### Caveats and policy implications

The study of the dynamics of the demand for food and animal feed has been hampered because of both data and method limitations. The food-feed controversy, as a result, remains unsolved.

Several empirical questions arise that are of special interest in studying the interactions between income and population growth. Consumption behaviour, especially with respect to direct and indirect consumption of cereals, has to be investigated across socio-economic classes (poor and middle class) and not only for the entire population as a function of income. The increase of the middle-income class has to be examined as a function of "graduation" and as a function of population growth. What are the graduation rules into middle-income class? How are they related to overall economic growth? Does population growth occur differentially among socio-economic classes? Obviously the same increase in population would have one impact on the demand for food if it occurred among the poor and it would have a different effect if it happened with the rich.



The most important policy questions probably arise with respect to prices. To what extent would high farm prices stimulate agricultural production and curtail the use of cereals for animal feed, and how much would they aggravate the nutritional problem of the poor? And conversely, what is the impact of cheap food prices on production and on diverting cereals from the poor to the use of the middle-income class? If indeed there is a problem, is there need for special intervention, such as pursuing cereal self-sufficiency, or could international trade and market prices be relied upon to provide a solution?

These broader issues in the study of the interrelations between population, agricultural and income growth are in the research agenda of FAO. Some of them are now being addressed in an ongoing study on "Agricultural price policies and agricultural/rural development of developing countries".

### Summary

The four main sections of this paper present the state of the art on certain aspects of population, resources and development that enter importantly into the work of FAO. The three former sections also present results on the specific issues and explore their policy implications. The section on food-feed competition, on the other hand, briefly presents both sides of a controversial issue for the purpose of provoking reaction and stimulating research into a topic that is of crucial importance for planning agricultural and economic development.

Questions that require further research are also raised in connection with the other issues covered in this paper. A few of these are highlighted in the following.

The carrying capacity project has characterized the potential human payload of lands of the developing world with respect to three levels of input/technology. None of these levels, however, refers to the actual situation prevailing in a specific country which is a mix of all three levels of input/technology. The description of the actual situation on the basis of the same rules is an important piece of unfinished business. More generally, a better and more detailed assessment of the lands is necessary in order to specify their optimal development for permanent use.

Both the carrying capacity project and the results of Agriculture: Toward 2000 have emphasized the importance of the role that technology is bound to play in world agriculture in the future. Technology, however, is not free and its cost should be compared to alternative solutions. Moving people - migration - is one option that suggests itself in relation to the carrying capacity project. Changes in certain institutions, including land reform, size of the farm, market systems, pricing regimes are another group of suggestions that may arise with respect to Agriculture: Toward 2000 and to the food-feed competition. Moreover, the ultimate nagging question still remains. Is high agricultural technology feasible on a world agricultural scale without dire environmental and other effects?



The agricultural employment data used in Agriculture: Toward 2000 were inadequate. Labour force composition data were not available. Better documentation of employment in agriculture at the aggregate level is hampered by the lack of systematic micro-economic data on farm management that could yield employment coefficients for different ecological, institutional and technological regimes. Unless this problem is tackled, the analysis of the absorptive capacity of agriculture or the migration movement will remain inadequate.

These are only few of the issues relating to population, agriculture and development that need to be reflected in the World Population Plan of Action.

#### Notes

1/ Food and Agriculture Organization of the United Nations, Agriculture: Toward 2000 (Rome, 1981), p.36.

2/ The length of the growing period is obtained by using a simple water-balancing technique between rainfall and potential evapotranspiration and taking account of temperature conditions.

3/ These are as follows: "low" level of inputs, assuming only land labour, no fertilizer and pesticide applications, no soil conservation measures and hence full productivity losses arising from land degradation, and the cultivation of all currently grown mixtures of crops on potentially cultivable rain-fed lands; "intermediate" level of inputs, assuming the use of improved hand tools and/or draught implements, some fertilizer and pesticide application, some simple soil conservation measures lessening productivity losses from land degradation, and the cultivation of a combination of the currently grown cultivable rain-fed lands; "high" level of inputs, assuming complete mechanization, full use of optimum genetic material, necessary farm chemicals and soil conservation measures, and the cultivation of only the most calorie-protein productive crops on potentially cultivable rain-fed lands. The actual situations, of course, involve a mix of all three input/technology levels. The project is not intended to describe the existing situation in a country.

4/ E. Boserup, The Conditions of Agricultural Growth (London, Allen and Unwin, 1965).

5/ The list accounts for 98.5 per cent of the population of the developing world (excluding China). Reference to developing countries in this section covers only those 90 countries.

6/ More specifically, the 1980 revision of the medium variant of population projections indicates that the end-of-century population in the 90 developing countries could be 153 million (or 4 per cent) below the 3,630 million projected in the 1978 assessment. This difference is the net result of upward and downward revisions for individual countries: the year 2000 population in 48 out of the 90 developing countries was revised upwards (32



countries in Africa), and for 42 countries (18 in Latin America and 11 in the Far East) population was revised downwards. Hence, while Africa's population shows a net increase of 20 million (from 668 to 688 million), Latin America shows a decrease of 44 million (from 601 to 557 million) and the Far East of 124 million (from 2,008 to 1,884 million).

7/ Allowing countries that have not reached self-sufficiency to decrease their production target in response to lower population pressure amounts, of course, to relaxing the general assumption that countries always strive for maximum self-sufficiency.

8/ This rule linking demand to production through the scarcity index by way of an assumed elasticity amounts to an average elasticity value of 0.12 for the low-scarcity countries (index 0 to 0.4), which means that the average decline in demand by 10.4 per cent is followed by an average decrease in production of only 1.2 per cent. In the very-high-scarcity countries, on the other hand (index between 0.9 and 1.0), the average value of the elasticity is 0.83 and the average decline in demand of 4.3 implies a decrease in production by 3.6.

9/ This approach distinguishes between undernutrition and malnutrition since the latter refers to "inappropriate" diets and may have an impact on all income groups. See S. Reutlinger and M. Selowsky, Malnutrition and Poverty: Magnitude and Policy Options, World Bank Occasional Paper No. 23, 1976; S. Reutlinger and H. Alderman, "The prevalence of calorie deficit diets in developing countries", World Development, vol.8 (1980), pp.399-440; and T.N. Srinivasan, "Malnutrition: some measurement and policy issues", Journal of Development Economics, vol.8 (1981), pp.3-19. It also abstracts from considering the other sub-standard quality-of-life indicators which are often correlates of poverty, such as poor health or housing. The latter relationship has led certain researchers to treat nutrition as an indicator of household welfare. See A.S. Denton, "Three essays on a Sri Lanka survey", Working Paper No.11, Living Standards Measurement Study (Washington, D.C., World Bank, 1981); and R. Martorell, "Nutrition and health status indicators: Suggestions for surveys of the standard of living in developing countries", Working Paper No.13, Living Standards Measurement Study (Washington, D.C., World Bank, 1982).

10/ Food and Agriculture Organization of the United Nations, Energy and Protein Requirements, Report of a Joint FAO/WHO Ad Hoc Expert Committee; FAO Nutrition Meetings Report Series No.52, WHO Technical Report Series No.522 (Rome, 1973).

11/ For a review of that literature, and a vigorous attack on the concept of energy requirements, see T.N. Srinivasan, "Hunger: Defining it, estimating its global incidence and alleviating it", paper presented at the Conference "The Role of Markets in the World Economy" (mimeo), 1982.

12/ Ibid.

13/ V.M. Dandekar and N. Rath, "Poverty in India", Economic and Political Weekly, Bombay, Nos. 1 and 2 (1971), and S. Reutlinger and M. Selowsky, op.cit.



14/ It is based on laboratory measurements of a sample of 2,200 persons over a period of 15 years.

15/ For an example of such data, see Food Balance Sheets. Also Food and Agriculture Organization of the United Nations, Agricultural Commodity Projections 1970-1980 (Rome, 1971).

16/ The relationship is postulated as  $C = a + b \ln X$ .

17/ For more detail on the methodology, see Food and Agriculture Organization of the United Nations, The Fourth World Food Survey (Rome, 1977), pp. 47-55.

18/ Animals are rather inefficient protein converters, with the calorie equivalent grain-meat conversion ratio (and thus the "shrinkage" of cereals) varying from 2.1 to 7.1.

19/ Food and Agriculture Organization of the United Nations, Agriculture: Toward 2000 (Rome, 1981).



## E. Population, environment and human needs

### The National Audubon Society

Although the global rate of population growth has moderated somewhat over the last decade, the revised United Nations projections provide no cause for complacency. Together with the impacts of rising consumption and increase in per capita resource use, the rise in human numbers from the current 4.6 billion to nearly 6 billion in the year 2000 - and more than 10 billion in the decades beyond - will lead to widespread degradation of natural resources and the environment. The struggle to meet basic human needs will in turn be undermined.

Although population pressure is seldom the sole cause of natural resource damage, it is often a major contributor. Conversely, stabilization of human numbers at levels lower than projected will not ensure the wise stewardship of resources, but continuation along the current demographic path will all but preclude significant improvements in environmental management and human conditions in many of the world's poorer countries. The ultimate consequences, such as reduced biological diversity, the impairment of natural goods and services on which economic activities are based, social disruptions and human misery, will affect people everywhere.

According to the medium United Nations projections, the population of Africa - where per capita food production is declining and large areas of fertile land are being turned to waste by overcropping, overgrazing and deforestation - is expected to quadruple before stabilizing. The population of Latin America - where urban shantytowns are mushrooming - will triple. And Asia's numbers are projected to rise from 2.5 billion to 6 billion. Obviously, social and technological changes of unprecedented scope will be required if anything near these totals is to be reached without widespread hunger and social breakdowns. Even these projections assume a progressive spread of birth control that is by no means assured. Because of the tremendous demographic momentum arising from the third world's youthful age structure, a rapid shift to small families in many cases just to prevent a rise in the rate of increase.

To the extent that the demographic pressures can be eased in a humane way - by simultaneously attaining low birth rates and low death rates - the formidable tasks of adjustment will be eased. In any case, adapting to massive population increases will almost certainly entail heavy environmental costs that will make our planet a less hospitable place.

Population-related social and ecological problems are already unfolding in the regions where future demographic growth will be the highest. The surge in human numbers, together with economic inequality, sluggish economic growth, and the scarcity of unexploited arable lands, results in increases in the number of "marginal" people - those who lack access either to good farmland or



to a productive job. Despite migration to cities, rural populations are still growing at close to 2 per cent a year in much of Africa and Asia, and land-settlement or colonization schemes cannot absorb more than a small fraction of the tide of potential farmers. The resulting rise in the number of landless people contributes to many other severe social and ecological problems, among them runaway urbanization, mass underemployment, and the destruction of soils, forests and wildlife.

Landless labourers, sharecroppers and marginal farmers together constitute the majority of rural residents in most countries of Asia and Latin America, and they are rising in number in Africa, where land inadequacy has only recently emerged as a serious problem. In non-socialist Asia, reports the Food and Agriculture Organization of the United Nations (FAO), some 30 per cent of the rural labour force is now completely landless. Perhaps as many more are farming marginal plots or renting under oppressive conditions. The concentration of larger holdings in a few hands joins population growth as an explanation for widespread landlessness. In Latin America, according to the FAO, 7 per cent of the landowners possessed 93 per cent of the arable land as of 1975, illustrating the need for attention to land tenure as well as to demographic patterns.1/

Throughout much of Sub-Sahara Africa, traditional tenure systems, in which land is owned by the tribe and allocated to individuals for use but not for sale, have historically predominated. The apparent availability of large "unused" areas has further fed the notion that landlessness is not a threat in Sub-Sahara Africa. This relatively benign image of African tenure problems is increasingly misleading. The empty spaces create a mistaken impression. In vast areas of Africa the climate, soils or other ecological factors make farming or even sustained grazing impossible. Elsewhere the soils and meager rainfall necessitate lengthy fallow periods if soil productivity is to be maintained - and economically feasible technologies for more intensive agriculture are often not available.

Land scarcity is emerging as a problem in more and more parts of Africa. Where populations are pressing against the arable land base, a common result has been a transition from tribal to individual land rights, accompanied by land accumulation by some and landlessness for others. The trends have progressed furthest in areas growing commercial export crops, such as West Africa's cocoa regions and East Africa's coffee lands. But they are fast appearing in peasant foodcrop areas as well.2/

The problem of landlessness in Sub-Sahara Africa may be most advanced in Kenya. By the early 1970s nearly one fifth of rural households were landless.3/ Kenya provides an ominous portent for the rest of black Africa. Doubling every 24 years or so, Africa's population is outpacing the expansion of cropped area, which, according to FAO data, increased by only 12 per cent between the early 1960s and 1975. Increasing land scarcity and competition are inevitable in much of the continent.

Throughout the third world, people who lack opportunities in the countryside often migrate to cities (or to other countries) in search of employment. Because of the combined effects of rural-urban migration and



natural increases among urban residents, developing country cities grew by an average of 4 per cent annually in the 1970s, overwhelming social capacities to provide adequate housing and services. Slums and squatter settlements are the fastest growing sectors of most third world cities. According to United Nations projections, cities will have to absorb even greater increases in population in the next two decades.<sup>4/</sup> Exactly how the mushrooming shantytowns will be supplied with adequate food, fresh water, fuel and housing is unclear.

In their desperate effort to meet current survival needs, marginal people are often forced to spread over the landscape - with disastrous effects on natural resources and wildlife.<sup>5/</sup> Due to circumstances beyond their control, the poor must take actions that undermine long-term development prospects for themselves and their countries.

The spread of agriculture outside of traditional farming zones is the largest single cause of deforestation in the developing countries today. Where lands are suitable and proper technologies are available, forest clearance for farming is often desirable, so long as it is accompanied by watershed protection, the preservation of natural areas and the enforcement of sustainable land uses. But much of today's deforestation is on lands that are not suited for agriculture; valuable species, other resources and ecological functions can be destroyed without commensurate social benefits.

Tropical rain forests have already been reduced from their natural domain by about 40 per cent, and, according to the recent FAO/UNEP assessment, are shrinking at a rate of 7.3 million hectares a year. The spread of peasant farming, shifting cultivation, commercial farming (especially the creation of pasturelands in Latin America to produce beef for export), and unregulated logging are the principal causes of rain forest clearance. But these figures, which describe the permanent decline of closed forests, understate the magnitude of the third world's deforestation problem. Another 4.4 million hectares per year of tropical closed forest are partially logged. In Africa and Latin America, an additional 3.8 million hectares of "open woodlands" are cleared, mainly for farming, each year. Throughout Africa, Asia and Latin America, the vegetative cover of huge areas is being severely degraded through overgrazing, fuelwood collection and a decline in crop fallow cycles.<sup>6/</sup>

The thoughtless clearance of tropical rain forests is of special concern to ecologists because unique biological riches are being lost even before scientists have had a chance to examine them. Thousands, possibly millions of plant and animal species, most of still unnamed, will become extinct over the next two decades if current trends in forest conversion continue.<sup>7/</sup> The costs - in terms of the loss of potential industrial and agricultural products, of genes useful in crop breeding, of new medical substances, of genetic materials for use in genetic engineering - will be substantial. The ecological impacts of such large-scale extinctions cannot be foreseen, but they must be cause for concern. Tropical forest disruption also threatens the wintering grounds of migratory birds that are ecologically and aesthetically important in countries of the temperate zone.

In hilly and mountainous regions, such as in the Himalayan hills, the Andes, Central America and East Africa, farmers increasingly clear steep



slopes that should be kept in forest or perhaps tree crops. Often the topsoil washes away within a few years, destroying the productive potential of the hills and causing serious problems downstream as reservoirs, canals and harbors fill with silt. Hillside deforestation, especially of smaller watersheds, also disrupts the hydrological cycle, resulting in increased flooding in rainy periods and desiccation of springs and streams in dry periods.

In semi-arid zones of Africa and Asia, farmers are forced to move into low-rainfall fringes that, when the inevitable drought comes, turn into dust bowls. Meanwhile, the spread of cultivation squeezes herders into ever more restricted areas and the problem of overgrazing is intensified. Often the emerging inadequacy of the land base in relation to population and available technology is partially concealed by a decline in the soil-preserving fallow period, a process that is turning huge fertile areas of semi-arid Africa and Asia into wasteland.8/

The loss of biological diversity and wildlife habitat that is occurring as the world's remaining natural areas are cleared for agriculture, logged, inundated by reservoirs, or otherwise disrupted is of special concern to the National Audubon Society. It is an unfortunate irony that many of the countries richest in biological resources are among the poorest economically. No system of parks and reserves is likely to withstand the demands for land and resources that will be posed by burgeoning numbers of destitute people, whatever the long-term costs to humanity of biological depletion.

The setting aside of a representative array of ecosystems, as is being promoted by the Biosphere Reserves program of the United Nations Educational, Scientific and Cultural Organization (UNESCO), should be an essential element in development planning. But the underlying threats to the integrity of such reserves must also be addressed. Direct financial assistance from richer countries for reserve establishment and maintenance is one need; if parks are set aside for the benefit of all humanity, then all humanity should help bear the costs. More basically, however, economic reforms that provide people with alternatives to invading protected areas are required. And even this will be insufficient if high rates of population growth continue.

Providing people with the opportunity to meet their basic needs and the encouragement of family planning can be mutually supportive. Both are required if the earth's biological diversity - so important for economic, ecological and spiritual reasons - is to be protected from massive assaults. And progress in both areas, experience shows, is feasible, most commonly where local people, especially women, participate in the planning of development and population programmes and are given adequate support.

In an effort to deny the importance of the population side of the population/resource balance, some have argued that each child is born not only with a mouth to feed but also with two hands for producing; that humans in effect "create" usable resources and that the growth rates or absolute size of populations do not warrant concern. But the relevance of this statement to the conditions prevailing in much of the world is dubious. Too many of today's infants will never go to school, will have no land to farm, will have



no access to a job productive enough to provide a decent income. Hundreds of millions will be inadequately nourished during childhood - some to the point of protein-deficiency brain damage, and they will lack ready access to safe water supplies; currently, according to WHO statistics, some 40,000 infants and small children die each day, mainly because of the combined effects of undernutrition and poor sanitation.<sup>9/</sup>

Arguments based on the roles of human effort and ingenuity in creating usable resources tend to ignore the extent to which human economic activities rely on natural systems, which in turn can be damaged by human misuse. Frequently, what is recorded in economic statistics as "growth" entails damage to biological capital such as fertile soils, forests, productive estuaries and natural ecosystems that provide checks against pests and disease. As a result, the long-term benefits to society are undercut.

Ever wider and more intensive exploitation of renewable resources can have heavy short-term costs as well, especially when poorer, politically marginal groups lose the resources on which their livelihoods are based. As a recent comprehensive report on environment and development in India concluded:

"...a significant section of India's population exists beyond the pale of the mainstream Indian society. Each time a major development project goes up, or there is a fresh inroad into the remote areas for untapped natural resources, a new ecological niche is destroyed and another lot of these marginal people are uprooted and pauperised."<sup>10/</sup>

Calculations of future carrying capacity also frequently fail to take full account of the costly trade-offs involved, the negative feedbacks, and the broader environmental consequences of achieving a certain goal. For example, calculations of ultimate food-producing potential often do not reflect the impacts of required reductions of forest area (and the resultant economic and ecological costs), or do not take full account of alternate demands on water supplies assumed to be available for irrigation. Calculations of potential economic output may ignore the impacts of increased atmospheric carbon dioxide and of increased pollution and acid rain, and may involve untested assumptions about the availability and costs of obtaining raw materials.

The point is not that economic development, and especially efforts to ensure that the basic needs of the world's poor shall be met, should not be pursued with urgency. But calculations of global and regional production possibilities often fail to take account of the hidden ecological and human costs of producing a given level of goods. They also tend to include totally unrealistic assumptions about the ability of societies to reorganize and plan activities and to redistribute goods.

We cannot dismiss the very real current challenges posed by rapid population growth simply because calculations can demonstrate the theoretical potential of a region to support some huge number of people. In many of the poorest countries, unchecked population growth will in all likelihood mean the continued razing of forests, the impoverishment of topsoils, the destruction of natural areas, the spread of urban shantytowns, food shortages, and minimal



economic progress at best. National and international economic reforms, improved land management strategies, and many other measures are obviously called for in addition to family planning services and population education. Reductions in those demands of the affluent that put stress on resources and the environment are vital as well. But to ignore the population factor is dangerous and irresponsible.

In the final analysis, the key question is not how many people could theoretically be supported by the earth's resources. One can make fantastic assumptions about social and technological change and environmental resilience and "prove" that many tens of billions can be supported, or one can make more static assumptions about human and environmental adaptability to "prove" that population has already surpassed the sustainable carrying capacity. A more germane question is, what the costs - ecological and human - of attempting to sustain ever more people. And, ultimately, what kind of world do we want for ourselves and our children? Short of all-out nuclear war, the human race could in some fashion survive the gross disruptions of the biota and natural cycles that will accompany large increases in population. But humankind would be poorer, both economically and spiritually, than it could be if population stabilized at lower levels.

The longer countries wait to address rapid population growth, the more stringent and less humane their ultimate responses are likely to be. China is in this regard instructive. Having determined that the attainment of a decent quality of life for its people requires a drastic slowdown and even reversal in population growth, the Chinese Government has embarked on what many regard as a Draconian birth control programme. In support of the goal of a one-child family, severe social and economic pressures are applied and personal privacy is intruded upon; even forced abortions are reported from some areas. Such measures may, in the long-term perspective, constitute the only realistic path available to China, given the size of its population in relation to resources and level of development. But China's predicament stands as a warning of the varied potential costs of procrastination in confronting high birth rates. Rapid population growth, grinding poverty and destructive consumption patterns present three interrelated challenges. Progress against each is possible and will facilitate progress against the other two. Progress against all three is essential to a better future for humanity.

#### Notes

1/ Food and Agriculture Organization of the United Nations, Review and Analysis of Agrarian Reform and Rural Development in the Developing Countries Since the Mid-1960s (Rome, 1979). See also Milton J. Esman, Landlessness and Near-Landlessness in Developing Countries (Ithaca, New York, Cornell University Center for International Studies, 1978).

2/ John M. Cohen, "Land tenure and rural development in Africa", in R. H. Bates and M. F. Lofchie, eds., Agricultural Development in Africa (New York, Praeger, 1980).



3/ International Labour Office, Employment, Incomes and Inequality: A Strategy for Increasing Productive Employment in Kenya (Geneva, 1972).

4/ M. W. Holdgate, M. Kassas, and G. F. White, eds., The World Environment 1972-1982 (Dublin, Tycooly International, 1982).

5/ Erik P. Eckholm, Down to Earth: Environment and Human Needs (New York, W. W. Norton, 1982).

6/ J. P. Lanly, Tropical Forest Resources (Food and Agriculture Organization of the United Nations, Rome, 1982).

7/ Norman Myers, The Sinking Ark (New York, New York, Pergamon Press, 1979); Entering the Twenty First Century: The Global 2000 Report to the President (Washington, D.C., Government Printing Office, 1980).

8/ Desertification: An Overview (Nairobi, United Nations Conference on Desertification, 1977); Eckholm, op. cit.

9/ Calculated from figures in World Health Organization, Sixth Report on the World Health Situation (Geneva, 1980).

10/ Centre for Science and Environment, The State of India's Environment 1982: A Citizens Report (New Delhi, 1982).







## F. Second study on industrial carrying capacity

United Nations\*

### Introduction

This study is a revision of a previous study on this topic carried out by UNIDO at the request of the Population Division of the United Nations for a system-wide analysis of the interrelations between population, resources, environment and development.<sup>1/</sup>

The previous study used the LIDO model <sup>2/</sup> to develop an economic scenario of the achievement of the Lima target, and further progress to the year 2025. The consequent demand for labour, key minerals and energy was then examined, and compared with estimates of supply for each of these essential resources. The essential conclusions of the study were that in none of these areas would shortages arise, and thus the world had the resource capacity, in terms of global balances, to meet its development aspirations.

The present study follows the same approach. The first section describes the economic scenario for world regions incorporating the achievement of the Lima target and showing the structural changes associated with it. The second section analyses employment, the third section key minerals, and the fourth section energy. The conclusions are summarized in the final section.

Some differences can be noted between this and the earlier study. The LIDO model itself has been updated for the present study, in particular by moving its base year of calculation from 1975 to 1980, for which new data are now available. New population projections have been incorporated,<sup>3/</sup> and the opportunity has also been taken to revise the analysis of key minerals and energy, using new sources of information.

### An economic scenario

#### The LIDO model

The scenario for the years up to 2025, which is the basis for this study, was prepared using the LIDO (Lima Industrial Development Objective) model. In its present form it gives details on five world regions (Africa, Asia, Latin America, the Middle East and the developed countries).<sup>4/</sup> It used an input-output accounting basis, dealing with four sectors: agriculture, mining, manufacturing and "others". (This last section includes construction and services.) The base year is 1980. The model here gives results for 1990, 2000 and 2025.

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\* United Nations Industrial Development Organization.



For each of the five regions the model produces a brief quantitative sketch of the economy in the solution year. This comprises an estimate of GDP and a four-sector decomposition of value added, consumption, investment, foreign trade and the input-output structure. All variables are measured in constant 1975 prices. To generate these outputs the model requires three groups of inputs: first, the "economic technology", comprising base year information and various economic relationships (many of which change with GDP per capita); second, exogenous targets - usually a regional distribution of the Lima targets; and, third, exogenous assumptions about each region's population and trade balance and about the developed countries' growth of GDP over the projection period. The trade balances reflect the net transfer of resources to each area in the solution year, but it is the GDP assumption that provides the main driving force of the model. The GDP of one region (up to now the developed countries) determines (through the "economic technology") the manufacturing value added, and this (again via the "economic technology") gives the overall economic growth rates of the developing regions.

#### The scenario assumptions

The principal assumptions made can be summarized as follows:

(a) That the Lima target will be achieved in the year 2000, with the following distributions: Africa 2 per cent, Asia 7 per cent, Latin America 13 per cent, Middle East 3 per cent;

(b) That annual average growth rates of GDP will be as follows:

1980-1990: Developed countries, 3.7 per cent; Developing countries as a whole, 7.4 per cent. (The rates for individual regions are based on historic rates. The International Development Strategy 5/ contains a (rounded) target of 7 percent for developing countries);

1990-2000: Developed countries, 3.9 per cent. (The growth rate for the developing countries for this period is part of the model solution, and is determined by the Lima targets);

2000-2025: Developed countries, 4.0 per cent; Developing countries, 6.0 per cent;

(c) That the overall trade surplus of the developed countries, with respect to the developing regions excluding the Middle East, in the year 1990 will be 0.8 per cent of their GDP, and in the years 2000 and 2025 it will be 1 per cent. The trade surplus of the Middle East will be halved by 1990 and will be zero by the year 2000.

(d) That agriculture in the developing countries, in terms of value added in that sector, will grow at no more than 3.6 per cent per year.6/



## GDP and population

From the description of the assumptions made, it can be seen that the exogenously given GDP growth rates will heavily influence the values of the generated scenario. Table 1 gives the annual average percentage figures for the regions and time periods of the scenario.

The overall growth rate of 7.4 per cent for the developing countries, in the decade 1980-1990, is distributed among each of the four developing regions in accordance with their historical performance in the years 1975-1980. This pattern of growth for the different developing regions changes again in the decade 1990-2000. This is because the growth rates are those necessary to achieve the regional distribution of the Lima target. In the case of Africa, its growth rate in this decade is lower than in the period 1980-1990. This is because its share of the Lima target (2 per cent) is relatively low. The Middle East keeps approximately the same growth rate; but the regions of Asia and Latin America must increase their GDP growth rates for the decade 1990-2000 in order to attain their required shares (7 and 13 per cent, respectively). It can be seen that the growth rate of Latin America is extremely high, fully reflecting its high share of the target. The figures for the period 2000 and 2025 have been obtained by supplying exogenous growth rates for the developed and developing regions. The figure of 4 per cent per year for the developed countries represents a slight improvement over the period up to 2000. The figure for the developing countries as a whole, on the other hand, represents a decrease and reflects an expectation that the high growth rates necessary to achieve the Lima target cannot be indefinitely sustained.

The exogenous assumptions as to population growth are important to the scenario in two ways. The first is that the structure of the LIDO model itself changes accordingly as the GDP per capita of the region concerned increases. The second is that the GDP per capita figures themselves give an indication of the extent to which such a scenario represents a step to overall economic development, insofar as GDP per capita is an indicator of this process. The population growth rates assumed are given in table 2, 7/ and table 3 shows the GDP per capita figures attained by each region in each of the years of the analysis. As table 1 shows, the developing countries out-perform the developed, in terms of GDP growth, in every stage of the period; nevertheless, because they also do so in terms of population, the result is that the gap in GDP per capita between developed and developing countries does not close over the 50-year period of the scenario, although it goes some way towards doing so. The second part of table 3 shows the GDP per capita of the developing regions as a percentage of that of the developed countries.

Overall it can be seen that the developing countries, which in 1980 had a GDP per capita of just over 10 per cent of that of the developed countries, will have in the year 2025 a figure that is still less than 19 per cent of that of the developed countries. Thus the high growth rates of GDP assumed in this scenario barely compensate for population growth. Indeed, if the individual developing regions are examined, it can be seen that the relative



Table 1. GDP annual growth rates for developing regions  
and developed countries, 1980-2025  
(Percentage)

	Africa	Asia	Latin America	Middle East	Developed countries	Developing countries
1980-1990	7.7 <u>a/</u>	7.7 <u>a/</u>	7.3 <u>a/</u>	6.8 <u>a/</u>	3.7 <u>a/</u>	7.4 <u>a/</u>
1990-2000	5	8.0	9.9	6.9	3.9*	8.2
1980-2000	6.4	7.9	8.6	6.8	3.8 <u>a/</u>	7.8
2000-2025	6.1	6.1	6.0	6.2	4.0 <u>a/</u>	6.0 <u>a/</u>

a/ Exogenous figures.



Table 2. Annual population growth rates, for developing regions and developed countries, 1980-2025  
(Percentage)

	Africa	Asia	Latin America	Middle East	Developed countries
1980-1990	3.9	2.31	2.36	2.93	0.65
1990-2000	3.00	1.44	2.11	2.56	0.54
2000-2025	2.41	1.15	1.71	1.81	0.32



Table 3. GDP per capita for developing regions and developed countries, 1980-2025  
(1975 US dollars)

	Africa	Asia	Latin America	Middle East	Developed countries	Developing countries
1980	468.3	230.3	1,337.0	1,591.9	3,170.8	533.3
1980	726.7	385.1	2,147.6	2,301.3	6,969.6	850.2
2000	884.5	720.1	4,478.3	3,468.5	9,682.2	1,538.0
2025	2,159.1	2,398.0	12,483.2	8,922.8	23,830.1	4,437.7

GDP per capita as a percentage of developed countries  
GDP per capita, 1980-2025

	Africa	Asia	Latin America	Middle East	Developed countries	Developing countries
1980	9.1	4.5	25.9	30.8	100.0	10.3
1990	10.4	5.5	30.8	33.0	100.0	12.2
2000	9.1	7.4	46.3	35.8	100.0	15.9
2025	9.1	10.1	52.4	37.4	100.0	18.6



position of Africa cannot be expected to improve, and the figure for Asia in 2025 is barely higher than that for Africa. Only Latin America and the Middle East make substantial progress, but even by the year 2025, they will have GDP per capita figures that are just over one-half and one-third, respectively, of that of the developed countries. The implications are, therefore, that neither the attainment of the Lima target, nor continued progress beyond it, suffice to assist the developing countries towards a tolerable level of development without further and special efforts. It can be seen from table 3, for instance, that even in the year 2025 neither Africa nor Asia can be expected to have a GDP per capita anywhere near that of the developed countries in 1980.

#### Manufacturing and structural change

Table 4 gives growth rates of manufacturing value added (industrial production) for the regions and periods concerned. For Africa a significant fall in growth of manufacturing is found for the second decade, since the region is already in sight of its relatively low Lima target share. The high share demanded for Latin America in 2000, however, calls for a further acceleration of manufacturing growth in the decade before this. Overall, for the period 1980-2000, the required growth rate of manufacturing value added for developing countries is 9.3 per cent, and it falls to 6.4 per cent for the period up to 2025, in accordance with the relatively lower growth of GDP.

Given that the developing countries are expected to continue to out-perform the developed countries for the period 2000-2025, their share of world manufacturing value added will increase beyond the shares given as targets for them in the year 2000. By 2025, therefore, Africa will have a share of 3.6 per cent, Asia 10 per cent, Latin America 16.3 per cent, and the Middle East 4.6 per cent. This gives a total of 34.6 per cent of world manufacturing value added for the developing countries in the year 2025, as against their target of 25 per cent in the year 2000.

Table 5 shows the composition of value added in terms of the four sectors with which this scenario deals. For the aggregates of developed countries and developing countries, it can be seen that even in the developed countries a change takes place in this distribution over the time period, while for the developing countries the transformation is very marked indeed. In the developing countries, manufacturing in 1980 had a share of total GDP of 19 per cent. One effect of the high manufacturing growth rates is to increase this share by the year 2000 to 25 per cent, and for it to rise further over the next 25 years to 27.7 per cent. Given such a rise in the percentage share, it can be seen that the burden of adjustment has marked effects on the agriculture and mining sectors, both of which decline in importance, while the "others" sector (which includes construction and services) increases its share of total GDP to a very substantial figure, that is, in the year 2025, slightly higher than that in the developed countries. The reason for such growth is the close linkages between manufacturing and the "others" sector. The decline of the agricultural sector's importance is due, in the developing countries, to the overall growth rate for its value added of 3.6 per cent, which has been imposed in this scenario for the whole period 1980-2025.



Table 4. Annual growth rates of manufacturing value added  
for developing regions and developed countries, 1975-2025  
(Percentage)

	Africa	Asia	Latin America	Middle East	Developed countries	Developing countries
1975-1980	7.45	7.95	5.0	4.8	3.2	5.9
1980-1990	11.2	10.4	7.7	9.9	3.7	9.0
1990-2000	6.5	9.3	10.3	9.8	4.4	9.6
1980-2000	8.8	9.8	9.0	9.8	4.1	9.3
2000-2025	7.6	6.6	6.0	6.9	4.5	6.4



Table 5. Distribution of value added, by sector,  
for developed and developing countries, 1980-2025  
(Percentage of GDP)

		Agriculture	Mining	Manufacturing	Other
Developed countries	1980	6.0	2.6	31.2	60.2
	1990	5.8	2.4	31.2	60.6
	2000	5.0	1.9	32.8	60.3
	2025	3.0	0.8	37.0	59.2
Developing countries	1980	17.3	11.5	19.0	52.2
	1990	12.1	10.3	22.0	55.6
	2020	7.8	8.7	25.0	58.5
	2025	4.4	7.0	27.7	60.8



Table 6 gives the detailed figures of the sectoral distribution of value added for the four developing regions, the aggregate figures having been presented in the previous table. It can be seen that the pattern of behaviour is broadly similar for all of them and thus the average behaviour of table 6 is representative. Looking at the manufacturing sector, it can be seen that its relative size will be greatest in Asia, in the year 2025, and smallest in Africa.

#### Final demand

In addition to value added, the scenario also contains details of the changes to be expected in final demand structures, i.e., the relative weights in GDP of consumption, investment, exports and imports. In fact, the LIDO model generates such figures, not only in the aggregate, but for each sector of each region. However, only the aggregate proportions are dealt with here and they are given in table 7 for developed and developing countries, and in table 8 for the four developing regions individually.

The behaviour of the investment share, i.e the proportion that investment forms of total GDP, closely follows the growth rate for the period in question. This is because the two are related by means of assumed incremental capital output ratios (ICORs). The values used are: Africa and Asia, 3.2; and Latin America and the Middle East, 3.6. The assumption for the developed countries is an ICOR of 5.7.

The consequences of these ICORs can be seen both from tables 7 and 8. In the year 2000, because of the high growth rates needed in the decade 1990-2000, the investment share rises to 28.9 per cent for the developing countries. Because of the differences in their growth rates over this period, the shares for Africa and Latin America are 16.1 and 35.6 per cent respectively. However, over the period up to 2025 the shares settle down to a range of around 20-22 per cent.

As far as trade is concerned, the tables show the effect of the imposed trade surpluses for the developed countries in the years 1990, 2000 and 2025. By the year 2000 the Middle East is assumed to have a balance in trade (which includes service trade) and the surplus of the developed countries is shared out between the other developing regions. The consequence of this is that for the developed countries, an expansion of both export and import shares in total GDP takes place which is significantly larger than the expansion for the developing countries. The extra growth for developing countries means that their share of world exports increases quite substantially. Thus, whereas, in 1980 it was 19.8 per cent, it would be 33.6 per cent in the year 2000, and show a further increase to 40.7 per cent in the year 2025.

#### The world employment potential

##### The employment scenario

As in the earlier study, an analysis is given of supply and demand for labour in the light of the economic scenario outlined in the preceding section.



Table 6. Distribution of value added, by sector,  
for developing regions, 1980-2025  
(Percentage of GDP)

		Agriculture	Mining	Manufacturing	Other
Africa	1980	21.8	16.1	9.7	52.4
	1990	14.6	16.3	13.3	55.9
	2000	10.6	16.0	15.3	58.2
	2025	6.0	12.5	21.3	60.1
Asia	1980	29.1	3.8	19.0	48.1
	1990	19.6	4.5	24.2	51.7
	2000	12.2	4.2	27.3	56.4
	2025	5.9	3.3	30.4	60.4
Latin America	1980	10.7	4.4	26.0	58.9
	1990	7.8	5.0	26.8	60.5
	2000	5.5	5.2	27.8	61.5
	2025	3.6	5.5	28.1	62.7
Middle East	1980	11.1	34.3	11.9	42.6
	1990	8.0	26.2	15.8	49.9
	2000	5.4	21.0	20.6	53.0
	2025	2.8	14.1	27.3	55.8



Table 7. Distribution of final demand components  
for developed and developing countries, 1980-2025  
(Percentage of GDP)

		Consumption	Investment	Exports	Imports
Developed countries	1980	77.8	22.0	19.9	19.7
	1990	77.8	22.0	21.0	20.0
	2000	77.0	22.2	22.0	22.0
	2025	76.2	22.8	27.2	26.2
Developing countries	1980	74.7	26.2	23.8	24.7
	1990	74.7	26.2	26.2	26.8
	2000	72.9	28.9	26.4	28.2
	2025	80.8	20.6	26.5	27.9



Table 8. Distribution of final demand components,  
developing regions, 1980-2025  
(Percentage of GDP)

		Consumption	Investment	Exports	Imports
Africa	1980	74.7	27.7	24.8	27.2
	1990	74.1	27.7	27.4	29.2
	2000	88.5	16.1	23.8	28.4
	2025	83.9	19.6	26.4	29.9
Asia	1980	78.9	25.6	25.9	30.4
	1990	75.6	25.6	32.5	33.7
	2000	76.8	25.6	34.2	36.5
	2025	82.2	19.6	35.3	37.1
Latin America	1980	74.6	27.2	14.5	16.4
	1990	73.6	27.2	17.0	17.8
	2000	65.7	35.6	19.2	20.5
	2025				
Middle East	1980	68.5	23.2	41.3	33.0
	1990	74.7	23.2	37.4	35.3
	2000	75.3	24.7	38.2	38.2
	2025	79.4	20.6	39.6	39.6



The same methodology and, indeed, the same behavioural relationships with respect to productivity are assumed. Due to lack of data, it is again not possible to use the disaggregation of each regional economy into the four scenario sectors. Instead the division into agriculture, industry and services is adopted, where industry includes mining, manufacturing and the construction part of the "others" sector. For the latter disaggregation the same proportions are used for the projections as were used in the past. However, the disaggregation of developed countries into market and centrally planned economies has not been followed, because it is felt that an estimation of differential sectoral growth rates is not meaningful without a full disaggregation of the input-output structure.

Tables 9 and 10 give the annual growth rates by economic sectors and regions that were determined on the basis of the above modifications. The most striking feature of the modifications is that, for the developing countries, the services sector will have the highest expansion rate. This is primarily due to the inclusion of mining in industry, since the mining sector in the original scenario is expected to grow only slowly.

### Productivity trends

In this study labour force requirements are determined by the scenario output and corresponding development of labour productivities (output per capita) in each sector and region. In order to be able to make appropriate assumptions with regard to the development of labour productivity over time and its relationship to economic growth, the evolution of labour productivities over the period 1960 to 1977, and sub-periods thereof, was analysed. Tables 11, 12 and 13 give the levels of labour productivity in the year 1980 and the growth and the relationship of productivities to economic growth for the period 1960 to 1977. Tables 12 and 13 are taken directly from the previous study, where it was explained that the analysis of growth rates and elasticities was supplemented by econometric analyses of productivity development on the basis of cross-section and time-series data, and that the figures presented (with the exception of the services sector where the growth of labour productivity is thought to be an underestimate) were felt to be a reasonable representation of actual developments.

The results of the foregoing analyses were applied in conjunction with the modified scenario to assess the development of labour force requirements by economic sectors and regions up to the year 2000. Table 14 gives the elasticity values that were used for the developing regions.

For the material production sectors (agriculture and industry) in developed countries, growth rates for labour productivity rather than elasticities were specified. The major reason for this assumption was that technical progress could be expected to have an autonomous development in developed countries in the future as well. In agriculture it was assumed that labour productivity in all developed countries would increase at an annual rate of 4.5 per cent, and in industry at 3.5 per cent. On the other hand, productivity growth in the services sector was considered to be primarily output dependent, with an elasticity of 0.6.8/



Table 9. Annual growth rates of GDP and sectoral value added,  
by regions, 1980-2000  
(Percentage)

	Agriculture	Industry	Services	Total GDP
Africa	2.58	8.05	6.12	6.36
Asia	3.24	9.31	8.81	7.85
Latin America	5.03	8.98	8.87	8.6
Middle East	3.01	6.36	8.2	6.82
Total developing	3.6	6.36	8.4	7.79
Total developed	2.94	3.9	3.81	3.8



Table 10. Annual growth rates of GDP and sectoral value added,  
by aggregated regions up to 2025  
(Percentage)

	Agriculture	Industry	Services	Total GDP
Developing countries				
1980-2000	3.6	8.20	8.5	7.79
2000-2025	3.6	6.11	6.18	6.00
1980-2025	3.6	7.04	7.21	6.79
Developed countries				
1980-2000	2.94	3.9	3.81	3.8
2000-2025	1.85	4.3	3.92	4.0
1980-2025	2.33	4.12	3.87	3.91



Table 11. Labour productivities (value added per capita), by economic sectors, for developing and developed regions, 1980 (In 1975 prices)

	Agriculture	Industry	Services	Total	GDP per capita
Africa	402.0	3,161.3	2,948.5	1,250.1	468.3
Asia	299.7	1,266.5	1,212.1	646.6	230.3
Latin America	1,333.1	6,896.6	5,190.9	4,299.6	1,337.0
Middle East	1,102.5	11,610.3	5,269.2	4,677.1	1,591.9
Total developing	446.2	3,529.3	2,756.3	1,517.2	533.3
Total developed	5,198.6	11,148.3	11,822.4	10,742.2	5,170.8

Source: Estimated by the UNIDO secretariat based on the UNIDO database, ILO Labour Force 1950-2000, vols. 1-6, ILO Yearbook on International Labour Statistics, and World Bank World Development Report, 1979.



Table 12. Annual growth rates of labour productivity from 1960 to 1977, for developing regions and developed economies  
(Percentage)

	Agriculture	Industry	Services
Africa	0.2	3.4	1.1
Asia	1.1	4.0	2.4
Latin America	2.5	2.4	1.6
Middle East	2.7	4.1	4.3
Developed market economies	4.6	3.7	1.6
Developed centrally planned economies	3.7	4.3	4.2

Source: Same as table 11.



Table 13. Elasticities of labour productivity with respect to value added, for developing regions and developed economies, 1960-1977

	Agriculture	Industry	Services
Africa	0.15	0.40	0.23
Asia	0.43	0.55	0.43
Latin America	0.71	0.38	0.27
Middle East	0.81	0.50	0.48
Developed market economies	2.98	0.83	0.37
Developed centrally planned economies	3.64	0.50	0.65

Source: Calculations by UNIDO secretariat based on table 11.



Table 14. Assumed elasticities of productivity growth with respect to value added, for developing regions, 1980-2000

	Agriculture	Industry	Services
Africa	0.20	0.45	0.45
Asia	0.50	0.55	0.60
Latin America	0.70	0.50	0.50
Middle East	0.80	0.45	0.50
Total developing <u>a/</u>	0.53	0.49	0.57

a/ Implicit elasticities resulting as the weighted average of the four regions.



In general, the specified growth rates or elasticities are quite close to historical values, but the elasticities of the services sector were raised throughout in order to take account of the above-mentioned biases in this sector. Finally, the assumption about productivity growth in the industrial sector of developed countries is that the development of labour productivity will not come to such a stand-still as United States experience might indicate. Given the rationalization potential indicated by large inter-country productivity differentials in many industries, and taking a not too pessimistic view with regard to future investments and innovations, the above assumption seems to be justified.

#### Labour force requirements and supply until 2000

The economic growth implied by the achievement of the Lima target will therefore yield, by the year 2000, the labour force requirements shown in table 15. Table 16 gives the changes in the sectoral distribution of the labour force according to this development pattern.

The major result is that, given the implied high economic growth rates, the available labour force will be absorbed by the economic system by the year 2000, i.e., the increase in employment opportunities will be sufficient to provide work for the rapidly growing labour forces, especially those of the third world.

The projected labour force supply for the year 2000 is 273.4 million in Africa; 767.5 in Asia; 207.3 in Latin America; 75.3 in the Middle East and 391.3 in developed market and 217.0 in developed centrally planned economies (1323.5 in developing and 608.3 in developed countries). When compared with the labour force requirements of table 15, the requirements in fact exceed the supply (16.5 million or 1.2 per cent for the developing countries and 27.9 million or 4.5 per cent for the developed countries). In Africa, Asia and the Middle East supply exceeds demand (-2.8, -5.6, -1.3 million), but the requirements in Latin America are 24.2 million higher than the projected supply. But these discrepancies are very much dependent on the distribution of the Lima target and how the consequent differential scenario growth rate in the decade 1990-2000 is subdivided. The conclusions are thus broadly similar to the previous study (although with an increased excess demand for labour) and they still give a reasonably well-balanced picture for the year 2000.

#### Labour force requirements and supply until 2025

Because of the increased uncertainties involved, the analysis for development beyond the year 2000 until 2025 was again carried out considering only the aggregated regions: total developing and developed countries. For the developing countries the elasticities for agriculture and services were further raised to 0.75 and 0.65, while the productivity growth in industry was assumed to be 3.5 per cent, corresponding to the 1975-2000 level. For the developed countries the productivity growth rate in agriculture was lowered to 4.0 per cent, for industry it was increased to 4.5 per cent, and the elasticity for the services sector was increased to 0.85.



Table 15. Labour force by sectors, for developing and developed regions, 1960-2000  
(Millions)

		Agriculture	Industry	Services	Total
Africa	1960	83.1	8.0	14.2	105.4
	1975	100.9	17.1	25.1	143.1
	1980	112.0	23.1	29.9	165.1
	2000	168.4	36.1	66.1	270.6
Asia	1960	236.3	32.8	53.3	322.4
	1975	294.1	53.0	85.4	432.4
	1980	297.8	68.8	107.3	473.9
	2000	409.7	152.6	211.4	761.9
Latin America	1960	33.5	14.0	22.4	70.0
	1975	38.8	25.0	41.8	105.5
	1980	39.0	25.5	48.6	113.1
	2000	52.3	60.1	113.7	231.5
Middle East	1960	19.1	4.1	5.0	28.2
	1975	21.0	7.4	9.8	38.1
	1980	21.2	9.8	13.9	44.9
	2000	23.9	19.2	30.7	74.0
Total developing	1960	372.0	58.9	94.9	526
	1975	454.8	102.5	162.1	719.1
	1980	470	127.2	199.7	797.0
	2000	654.3	268	421.9	1340
Total developed	1960	124.0	151.3	161.1	436.4
	1975	84.2	194.9	236.4	515.5
	1980	66.7	214.2	261.9	542.8
	2000	49.8	233.2	353.2	636.2

Source: Figures for 1960, 1975 derived from ILO Labour Force 1950-2000, 1980 figures are estimated and those for 2000 are scenario figures.



Table 16. Labour force distribution, by sectors, for developing regions, 1960-2000  
(Percentage)

		Agriculture	Industry	Services
Africa	1960	78.8	7.6	13.5
	1975	70.5	11.9	17.5
	1980	67.8	14.0	18.1
	2000	62.2	13.3	24.4
Asia	1960	73.3	10.2	16.5
	1975	68.0	12.3	19.8
	1980	62.8	14.5	22.6
	2000	53.8	20.0	27.7
Latin America	1960	47.9	20.0	32.1
	1975	36.8	23.7	39.6
	1980	34.5	22.5	43.0
	2000	22.6	26.0	49.1
Middle East	1960	67.7	14.5	17.7
	1975	55.1	19.4	25.7
	1980	47.2	21.8	31.0
	2000	32.3	25.9	41.5

Source: Calculated from table 15.



As stated in the previous report, these are quite strong assumptions, and the likelihood is that the advancement of labour productivities will be slower, rather than more rapid. But these comparatively strict assumptions still lead to a growth of labour force requirements by the year 2025 which nearly matches the available labour force supply. The labour supply is obtained from the new population figures and the old extrapolated participation rate (rising in developing and falling in developed countries) and is shown in table 17.

Tables 18 and 19 give the long-term evolution of the labour force requirements and the distribution by economic sector. When the required labour force, by the year 2025 (2,029.7 million for developing and 659.7 million for developed countries, yielding a total of 2,689.4 million in comparison with 1,339.8 million in 1980) is compared with the available labour force supply, an excess demand as much as 165.9 million or 8.9 per cent for developing, and 30.5 million or 4.8 per cent for developed countries is to be expected. While such a long-term analysis is a very uncertain exercise, the fact that the previous study indicates an excess demand is an interesting one, and points to a conclusion that unemployment may not be a problem, at least at a global level, if such a world economic development scenario as is here proposed becomes a reality.

### The adequacy of non-fuel minerals

#### Supply of key minerals

This section looks at supply and demand for seven key minerals. They are aluminium, copper, iron, lead, nickel, tin and zinc. All are metals. Together they are by far the largest part of the world's non-fuel mineral production. Technological changes in the future may give new importance to a metal other than one of these, but at present it is clear that these seven are being extensively mined and processed, and constitute essential inputs to the economy as a whole. This section therefore attempts to answer the question: will these minerals be available in sufficient quantities in the future to sustain the high growth rates necessary for the Lima target and beyond?

There are once more two stages of analysis: the estimation of supply and that of demand. The former stage requires a consideration, however, of the different definitions of supply in the context of mineral extraction. These include reserves, which are the amount of a mineral exploitable under present conditions and resources which include reserves, known deposits not at present exploitable, and also hypothesized unknown deposits.<sup>9/</sup>

Changes in technology and economic conditions bring about shifts between reserves and resources, as previously inaccessible or low-grade deposits may through new techniques or increased demand become worthwhile for exploitation. Similarly previously exploitable deposits of minerals may, due to changed economic conditions, become no longer worth exploiting and would thus be regarded as resources rather than reserves. Both the concepts tend to be revised upward over time.



Table 17. Population and labour force supply, for developing and developed countries, 1980-2025  
(Millions)

		Population	Participation rate	Labour force
Developing countries	1980	2,305.9	35.8	825.5
	2000	3,372.0	36.1	1,217.3
	2025	5,106.2	36.5	1,863.8
Developed countries	1980	1,131.3	45.9	519.3
	2000	1,272.2	45.8	582.7
	2025	1,376.8	45.7	629.2
Total	1980	3,437.2	39.1	1,344.8
	2000	4,644.2	38.7	1,800.0
	2025	6,483.0	38.4	2,493.0

Source: Population figures from United Nations, World Population Prospects as Assessed in 1980..., Labour force figures from ILO, Labour force 1950-2000, and participation rates calculated therefrom.



Table 18. Demand for labour, by economic sectors, for aggregated regions, 1960-2025  
(Millions)

		Agriculture	Industry	Services	Total
Developing countries	1960	372.0	58.9	94.9	526.0
	1975	454.8	102.5	162.1	719.1
	1980	470.0	127.2	199.7	797.0
	2000	654.3	268.0	421.9	1,340.0
	2025	816.2	500.3	713.2	2,029.7
Developed countries	1960	124.0	151.3	161.1	436.4
	1975	84.2	194.9	236.4	515.5
	1980	66.7	214.2	261.9	542.8
	2000	49.8	233.2	353.2	636.2
	2025	29.5	222.2	408.0	659.7
Total	1960	496.0	210.2	256.0	962.4
	1975	539.0	297.4	398.5	1,234.6
	1980	536.7	341.4	461.6	1,339.8
	2000	704.1	501.2	775.1	1,976.2
	2025	845.7	722.5	1,121.2	2,689.4

Source: See table 17. Figures for 2000 and 2025 come from the scenario.



Table 19. Distribution of the labour force, by sectors for aggregated regions, 1960-2025  
(Percentage)

		Agriculture	Industry	Services
Developing countries	1960	70.7	11.2	18.0
	1975	63.2	14.3	22.5
	1980	59.0	16.0	25.0
	2000	48.8	20.0	31.5
	2025	40.2	24.6	35.1
Developed countries	1960	28.4	34.7	36.9
	1975	16.3	37.8	45.9
	1980	12.3	39.5	48.2
	2000	7.8	36.7	55.5
	2025	4.5	33.7	61.8
Total	1960	51.5	21.8	26.6
	1975	43.7	24.1	32.3
	1980	40.1	25.5	34.5
	2000	35.6	25.4	39.2
	2025	31.4	26.9	41.7

Source: Calculated from table 18.



Table 20 shows estimates of world mineral reserves for the seven metals, and an increase can be seen for all if the earliest and latest available figures are compared. The same is true of resources figures as shown in table 21. Reserves are, of course, smaller than resources, following the definition given above. A comparison of the estimates for 1979 shows that reserves are at most 60 per cent of resources (for aluminium) and as little as 5 per cent (for zinc). Thus, apart from reserves, a substantial supply is at least theoretically available. The estimates contained in these tables include those from more recent sources than were available at the time of the previous study.

### Demand for key minerals

Having established estimates of world reserves and resources, the next step is to determine demand for the key minerals on the basis of the economic scenario presented earlier in this paper. It will be recalled that the assumptions of this scenario included the achievement of the Lima target and somewhat reduced growth rates thereafter.

The previous study employed estimated elasticities of consumption to GDP for each of the minerals, and thus obtained estimates of consumption and cumulative consumption over the scenario period. For the present study it has been possible to derive more precise estimates, by investigating the functional relationship between consumption and the growth of the manufacturing sector. Since this sector can be assumed to be the only consumer of the minerals, it is felt that this procedure may yield more accurate estimates than a relationship between consumption and GDP as a whole.

The results of the econometric analysis are shown in table 22, which gives the functional relationship estimated for the seven minerals with respect to manufacturing value added. The data used covered the years 1969-1980. The estimated relationships reflect the decreasing role of mineral-intensive industries in the manufacturing sector as a whole in developed countries. In general, the functions are very simple ones, but they seem reasonable from several points of view and may give an indication of consumption of those key minerals in the context of the Lima target and beyond.

Table 23 shows the 1975 historical values of consumption of the seven minerals for 1975 and the scenario estimates, deriving by using the estimated functions for 1980, 1990, 2000 and 2025. (For iron ore, the 1980 figures are actual data rather than estimates.) It can be seen that the developing regions' share of world consumption increases in line with the achievement of the Lima target. Given the differential in growth rates these shares increase further by 2025 so that the developing countries' consumption of tin and zinc, for instance, would be more than half of the world total. Such figures of course assume both the validity of the economic scenario and of the proposed relationship between growth and mineral consumption, but they at least indicate the broad dimensions under present technology of future demand for key minerals and point also to the changing structure of economic relationships between North and South implied by the Lima target.



Table 20. Estimated world mineral reserves, 1968-1981  
(Million tons)

	Aluminium	Copper	Iron	Lead	Nickel	Tin	Zinc
1968 a/	1,060	200	80,000	86	67	4.5	112
1973 b/	3,270	335	88,000	130	42	4.5	120
1974 c/	3,480	408	91,000	150	54	10.0	236
1976 d/	5,600	503	103,000	136	60	10.0	166
1979 e/	4,717.3	494	103,000	127	60	10.0	162
1981 f/	n.a.	551	93,600	156	82	9.7	241

a/ L.L. Fishman and H.H. Landsberg, "Adequacy of non-fuel minerals and forest resources", in Population Resources and the Environment, R.G. Ridker, ed., in United States Commission on Population Growth and the American Future, vol. 3 (Washington, D.C., United States Government Printing Office, 1972).

b/ I. Rajaram, "Non-renewable resources: A review of long-term projections", in Futures, vol. 8, No. 3 (June 1976).

c/ K. J. Walker, "Materials consumption implications of a fully industrialized world", in Resources Policy, vol. 5, No. 4 (December 1979).

d/ Entering the 21st Century: Global 2000 Report to the President (Washington, D.C., United States Government Printing Office, 1980).

e/ United States Bureau of Mines, Mineral Facts and Problems, (Washington, D.C., United States Government Printing Office, 1980).

f/ Regional distribution of mining production and reserves of mineral commodities in the world, Federal Institute for Geosciences and Natural Resources, Federal Republic of Germany, January 1982.



Table 21. Estimates of world mineral resources  
(Million tons)

	1974 <u>a/</u>	1977 <u>b/</u>	1979 <u>c/</u>
Aluminium (Bauxite)	5,720	8,000	8,028
Copper	1,860	2,220 <u>d/</u>	2,316 <u>d/</u>
Iron	195,000	236,000	217,000
Lead	-	1,370	288
Nickel <u>e/</u>	112	157	228
Tin	21	37	37
Zinc	1,506	4,160	4,380

a/ K.J. Walker, "Materials consumption implications of a fully industrialized world", Resources Policy, vol. 5, No. 4 (December 1979).

b/ Entering the 21st Century: Global 2000 Report to the President (Washington, D.C., United States Government Printing Office, 1980).

c/ United States Bureau of Mines, Mineral Facts and Problems (Washington, D.C., United States Government Printing Office, 1980).

d/ Including 690 million tons of copper from deep-sea nodules.

e/ Excluding deep-sea nodules.



Table 22. Results of regression performed for each mineral and region, 1969-1980

	Aluminium	Copper	Iron	Lead	Nickel	Tin	Zinc
<b>Africa</b>							
Coefficient	4.41	1.42	59.6	2.24	--	0.12	2.25
Standard deviation	(+0.3)	(+0.07)	(+3.1)	(+0.11)	--	(+0.06)	(+0.1)
$r^2$	0.949	0.973	0.974	0.991	--	0.74	0.982
<b>Asia</b>							
Coefficient	8.87	2.75	196.04	2.34	9.11	0.8	5.14
Standard deviation	(+0.21)	(+0.090)	(+3.73)	(+0.03)	(+0.009)	(+0.109)	(+0.14)
$r^2$	0.994	0.989	0.997	0.999	0.934	0.75	0.993
<b>Latin America</b>							
Coefficient	4.62	3.31	140.83	1.47	0.08	0.96	2.48
Standard deviation	(+0.175)	+0.11	(+4.09)	(+0.07)	(+0.008)	(+0.03)	(+0.06)
$r^2$	0.986	0.989	0.992	0.992	0.918	0.989	0.995
<b>Developed countries</b>							
Coefficient	10.0	4.95	11,278.6	110.3	0.39	0.09	127.6
Standard deviation	(+0.14)	(+0.11)	(+193.8)	(+1.4)	(+0.009)	+0.14	(+2.6)
$r^2$	0.358	0.995	0.997	0.999	0.995	0.193	0.996

Source: Calculated by the UNIDO secretariat.



Table 23. World mineral consumption, 1975-2025  
(Million tons)

	Aluminum	Copper	Iron	Lead	Nickel	Tin	Zinc
Africa	1975	0.07	0.74	0.04	...	0.002	0.03
	1980 <u>a/</u>	0.09	1.26 <u>b/</u>	0.04	...	0.002	0.04
	1990 <u>a/</u>	0.25	3.43	0.13	...	0.007	0.13
	2000 <u>a/</u>	0.48	6.44	0.24	...	0.013	0.24
	2025 <u>a/</u>	2.95	39.87	1.50	...	0.08	1.50
Asia	1975	0.46	10.11	0.12	0.005	0.009	0.23
	1980	0.70	15.45	0.18	0.010	0.014	0.41
	1990	1.95	43.14	0.51	0.025	0.039	1.13
	2000	4.80	106.07	1.26	0.061	0.096	2.78
	2025	24.26	536.41	6.40	0.307	0.489	14.07
Latin America	1975	0.47	13.26	0.12	0.009	0.008	0.23
	1980	0.58	18.13	0.19	0.011	0.012	0.31
	1990	1.22	37.25	0.39	0.022	0.025	0.65
	2000	3.25	99.0	1.03	0.059	0.068	1.74
	2025	14.03	427.67	4.46	0.255	0.292	7.52
Developing countries	1975	1.0	24.11	0.28	0.014	0.019	0.49
	1980	1.37	34.84	0.41	0.021	0.028	0.76
	1990	3.42	83.82	1.03	0.047	0.071	1.91
	2000	8.53	211.51	2.53	0.12	0.177	4.76
	2025	41.24	1,003.95	12.36	0.562	0.861	23.09
Developed countries	1975	13.58	443.37	4.07	0.54	0.18	4.35
	1980	18.41	435.68 <u>b/</u>	4.71	0.72	0.22	5.45
	1990	26.44	578.67	5.66	1.03	0.26	6.55
	2000	40.76	718.51	7.02	1.59	0.32	8.13
	2025	122.55	1,245.88	12.18	4.77	0.56	14.10
Total	1975	14.58	467.48	4.35	0.55	0.19	4.84
	1980	19.78	470.52	5.12	0.74	0.25	6.21
	1990	29.86	662.49	6.69	1.08	0.33	8.46
	2000	49.29	930.02	9.55	1.71	0.50	12.89
	2025	163.79	2,249.83	24.54	5.33	1.42	37.19

Source: World Mineral Statistics 1970-1974, 1972-1976, 1974-1978, Institute of Geological Sciences.

a/ Estimate.  
b/ Observed value.



### World balances

Table 24 shows the cumulative consumption of key minerals on the basis of the relationships described above, i.e., the consumption is summed up for the 20 years 1980 to 2000. The table allows one to contrast these figures with those for estimates of reserves in 1980. These estimates are an interpolation between the 1979 and 1981 estimates presented in table 20. The third column shows the extent to which these figures can be regarded as being depleted by the cumulative consumption: thus, for instance, world aluminium consumption will have used 14 per cent of estimated reserves by the year 2000. The final column in the table shows the year in which exhaustion (100 per cent use) would take place, given the growth rates for manufacturing for the scenario period 2000-2025.

It should be stressed that these are world balances. Demand has been calculated on a regional basis, but reserves have been figured on a world basis (in both cases excluding centrally planned Asia). Thus even though present reserves appear sufficient to meet demand generated by the achievement of the Lima target, there may be important implications in terms of interregional co-operation, and consequent new patterns of international trade for the satisfaction of this demand.

With regard to the years 2000-2025, the fourth column of table 25 presents what is at first sight a less encouraging picture, since only aluminium and iron ore appear to have reserves sufficient to meet demand up to 2025. But it should be noted first that these are reserve estimates for 1980, and technological and economic change can be expected to transform at least a part of present resources into reserves. For instance, one estimate of copper resources in seabed nodules alone is around 690 million tons (see table 21). Again, consideration of the uses of these minerals indicates several reasons why technological change would also reduce the growth of demand from that suggested here.<sup>10/</sup> Lead, for instance, is used largely for storage batteries and as a petrol additive. Intensive research continues in the first field and environmental pressures can be expected to continue to reduce usage of the second type.

Table 25 gives a picture of demand versus supply to the year 2025, using resources rather than reserves as a measure of supply, and using the latter growth rates of consumption to calculate cumulative consumption up to 2025. It can be seen that only resources for lead are exhausted by then. Given the considerations mentioned above with respect to this metal, and also its considerable recycling possibilities, this conclusion is not as ominous as it might at first appear.

It remains true, however, that the need to rely on resources rather than reserves for the period 2000-2025 has serious implications for investment, technological progress, conservation and recycling. In all of these areas international co-operation will clearly be essential to achieve an efficient, equitable and rational exploitation of resources. The alternative could be a serious disruption of economic growth on a world-wide basis.



Table 24. World consumption and reserves of key minerals  
(Million tons)

	Cumulative consumption 1980-2000	Current reserves	Consumption as percentage of current reserves	Year of reserve exhaustion
Aluminium	661.3	4,750	13.9%	2,035
Copper	316.0	525	60.2%	2,009
Iron	13,718.4	97,500	14.1%	2,042
Lead	144.4	150	96.3%	2,002
Nickel	23.6	75	31.5%	2,020
Tin	7.3	10	73.0%	2,006
Zinc	186.3	200	93.2%	2,002

Source: Based on table 20, with estimates based on regression results of table 22 and the scenario.



Table 25. World consumption and resources of key minerals, 2000-2025

	Consumption by the year 2000	Assumed growth 2000-2025	Consumption by the year 2025	Cumulative consumption 2000-2025	Current resources	Consumption in percentage of current resources	Year of resource exhaustion
	----- (Million tons) -----						
Aluminium	49.29	4.92	163.79	2,421.4	8,028	30.4	2046
Copper	23.58	4.87	77.43	1,159.4	2,316	50.0	2037
Iron	930.02	3.59	2,249.83	38,013.6	217,000	17.5	2063
Lead	9.55	3.85	24.54	414.2	288	143.8	2020
Nickel	1.71	4.65	5.33	81.4	228	35.7	2044
Tin	0.5	4.26	1.42	22.5	37	60.8	2035
Zinc	12.89	4.33	37.19	585.6	4,380	13.4	2065

Source: Based on table 21, with estimates using regression results of table 22 and the scenario.



## Energy requirements and supply

### Sources of energy

According to the Second Law of Thermodynamics, energy can neither be created nor destroyed. A certain looseness of expression can therefore be identified in international debate on energy issues when phrases such as "an energy shortage" or "an energy crisis" are used. In fact, all natural processes involve the conversion of energy from one form to another, whether thermal, kinetic or other. The "energy crisis" nevertheless exists: but it is a crisis with respect to the sources of energy. The possible exhaustion of traditional sources means that a perhaps difficult and costly transformation of present uses of energy may be necessary in order to exploit new sources. And for many of these, the technology is not yet sufficiently developed.

This section of the study concentrates on traditional energy sources, those actually used by the manufacturing and other sectors, such as, in particular, coal, crude petroleum and natural gas. It attempts to measure the rate at which resources of these are being depleted, and the likely corresponding exhaustion of these resources if the present scenario is followed and the substitution of other sources does not take place. The study is thus not entirely analagous with that of key minerals in the preceding section. This is because key minerals are used in the manufacturing process and embodied in the final product. Indeed, they determine the nature of the final product. The industrial use of energy, on the other hand, is not conceptually linked with the source of that energy. A manufacturing plant might use electricity to drive its machines: it is irrelevant (apart, of course, from the cost aspects) whether that electricity was generated by nuclear, hydroelectric or coal-fired power stations. Transformations of technology are, of course, necessary for other types of plant and other types of use: the substitution of other energy sources for petroleum in private transport is one example. It is true that existing cars can be modified fairly easily to run on alcohol or on liquified natural gas, but if these as well as oil were also to be unavailable, then major technological change might be necessary.

### The development of demand for selected energy sources

The previous study on industrial carrying capacity in its treatment of energy relied upon a number of independent projections of energy consumption to assess the likely future demand for both commercial and other energy sources. The present study attempts to make the treatment of energy more uniform, in that the relationship between growth and three selected energy sources is estimated, just as for labour and for key minerals, and then the resulting relationships are applied to the scenario growth rates as set out in the beginning of this study. The future consumption is thus derived and compared with estimates of reserves and resources in this field, and thus, once again, the balance between supply and demand is assessed.



Time series data on the consumption of coal, crude petroleum and natural gas were available for the years 1970 to 1980.<sup>11/</sup> These data were then used in the estimation of a simple functional relationship for each of the three energy sources and for each of the regions. The relationship was as follows:

$$\text{Ln consumption} = A + B \text{ Ln GDP}$$

The estimation procedure yielded, in general, satisfactory fittings of this relationship. The estimated coefficients are given in table 26.

Interregional variations between the estimated coefficients can certainly be seen from this table. It should be remembered, however, that the independent variable is GDP, which itself is composed of a number of sectors which will have different energy intensities, and that structural differences between the regions as to their sectoral composition of value added are significant. The variation in the estimated coefficients would also reflect relative efficiencies, and, in particular, steps that may have been taken in the decade 1970-1980 in order to use energy more efficiently. Variations in these steps would also be reflected in the coefficients. Nevertheless, the use of these functional relationships for projections in the future must be done with some reservation: this is principally because structural change, subsumed in these average relationships estimated for the period 1970-1980, can be expected to continue in the future. The relative weights of the different sectors in GDP as a whole will thus alter, bringing about changes in the average relationship between energy-type consumption and GDP. In particular, the emphasis in the present scenario on manufacturing growth, and the increase in its share of GDP in the developing regions especially, may alter the relationship between energy consumption and GDP as a whole. However, equations may provide some initial estimates and at least indicate roughly where shortages can be expected to occur.

Table 27 gives actual data on consumption, for the five regions and for the three energy sources, for the years 1970, 1975 and 1980. For the decade 1990-2000, and for 2025, the functions as defined in table 26 have been applied to the scenario growth rates of GDP for each region and the estimated consumption derived. As can be seen, no account is taken at this stage of regional reserves and resources: thus the consumption is assumed to grow in accordance with the observed relationship irrespective of whether that region can itself meet the demand.

#### Selected energy reserves and resources

Table 28 gives the estimated reserves of the three types of traditional energy sources considered. The figures are all in million tons of oil equivalent. The table is an estimate, in that, as is noted, world totals have been regionally distributed according to the distribution from another source. The figures show that while developing countries as a whole have rather more coal and rather less natural gas than developed countries, they have an overwhelming preponderance of world crude petroleum reserves. Table 29 gives the estimated resources. The table is taken over from the previous study and includes some disaggregation of both oil and coal and adds uranium,



Table 26. Coefficients estimated to forecast future energy consumption, for developing regions and developed countries, 1970-1985

		Coal	Crude petroleum	Natural gas
Africa	A	325.5	36.47	3.539
	B	0.498	1.35	1.35
	r <sup>2</sup>	0.984	0.944	0.886
Asia	A	611.69	296.99	12.03
	B	0.894	1.098	1.234
	r <sup>2</sup>	0.999	0.998	0.975
Latin America	A	7.568	3,231.62	39.5
	B	1.25	0.75	1.15
	r <sup>2</sup>	0.996	0.995	0.994
Middle East	A	7.86	1,035.24	7.42
	B	1.368	0.912	1.059
	r <sup>2</sup>	0.99	0.986	0.99
Developed countries	A	4,220.3	1,822.97	685.62
	B	0.711	0.829	0.85
	r <sup>2</sup>	0.999	0.999	0.999



Table 27. Consumption estimates for selected energy types, for developing regions and developed countries, 1970-2025  
(Million tons of oil equivalent)

	Year	Coal	Crude petroleum	Natural gas
Africa	1970	4.3	19.9	0.4
	1975	4.6	35.1	3.3
	1980	3.7	50.1	6.9
	1990	6.7	132.3	12.8
	2000	8.6	257.2	25.0
	2025	18.0	1,916.4	186.0
Asia	1970	63.8	81.8	4.4
	1975	81.8	108.0	9.7
	1980	105.6	157.0	16.5
	1990	200.9	366.5	36.0
	2000	393.9	838.0	91.2
	2025	1,490.6	4,296.9	573.1
Latin America	1970	9.1	261.4	26.6
	1975	12.2	289.1	34.5
	1980	17.4	310.4	53.9
	1990	41.8	568.7	109.6
	2000	136.1	1,154.3	324.4
	2025	832.6	3,422.0	1,716.8
Middle East	1970	6.5	110.8	13.0
	1975	8.8	107.5	19.2
	1980	12.9	117.4	25.8
	1990	29.0	248.0	43.0
	2000	71.8	454.2	86.7
	2025	483.0	1,619.6	379.5



Table 27 (continued)

	Year	Coal	Crude petroleum	Natural gas
Developing countries	1970	83.7	473.9	44.4
	1975	107.4	513.2	66.7
	1980	139.6	634.9	103.1
	1990	278.4	1,315.5	201.4
	2000	610.4	2,703.7	527.3
	2025	2,824.2	11,254.9	2,855.4
Developed countries	1970	1,710.7	1,771.9	788.1
	1975	1,779.2	2,070.5	933.6
	1980	2,011.1	2,249.3	1,093.2
	1990	2,621.6	3,282.7	1,491.9
	2000	3,441.5	4,508.0	2,065.2
	2025	6,913.0	10,163.2	4,752.6
Total	1970	1,794.4	2,245.8	832.5
	1975	1,886.6	2,583.7	1,000.3
	1980	2,150.7	2,884.2	1,196.3
	1990	2,900.0	4,598.2	2,266.6
	2000	4,051.9	7,211.7	2,592.5
	2025	9,737.2	21,418.1	7,608.0

Source: Yearbook of World Energy Statistics 1981, (United Nations publication, Sales No. E/F.82.XVII.16) the regression results of table 26 and the scenario.



Table 28. Energy reserves, for developing regions and developed countries  
(Million tons of oil equivalent)

	Coal	Oil		Gas
		Crude petroleum reserves	Recoverable oil, proved reserves in place	Natural gas
Africa	7,370.6	7,179.2	...	5,433.4
Asia	38,432.0	2,113.7	...	3,711.9
Latin America	11,161.3	7,101.2	...	3,711.9
Middle East	842.4	44,941.4	...	19,181.4
Developing countries	55,806.3	61,335.5	...	30,746.8
Developed countries	482,882.4	16,699.5	...	35,518.9
Total	538,688.7 <sup>a/</sup>	78,035.0	81,138.0	66,265.7

Source: Yearbook of World Energy Statistics (United Nations publication, Sales No. E/P.81.XVII.10); regional distribution taken from "Statistical Review 1980", Energy Economics Research Institute, Ltd.

<sup>a/</sup> Out of this total, 267,714.3 million tons are for hard coal and 270,974.4 are brown coal.



Table 29. Estimated world resources  
(In 10<sup>3</sup> Million tons of oil equivalent)

	Estimated resources	Technically recoverable	Current economically recoverable
Conventional oil	700	290	90
Unconventional oil			
Tar sands	350	520	70
Oil shale	490		
Natural gas	280	210	70
Coal			
Hard coal	5,600	840	420
Brown coal, lignite	1,400		
Uranium used for light water reactors, breeder reactors	- -	170 10,500	80 4,550
Total		2,030 (12,360)	730 (5,210)

Source: Mobil Oil AG, Federal Republic of Germany (1979).



which has not yet been included in this analysis. The distinction between reserves and resources is broadly speaking that which was assumed in the previous section on key minerals. Accordingly, as was noted in the earlier study, the definition of reserves implies not only the technological feasibility of exploiting a mineral deposit, but also economic criteria such as profitability under current economic conditions. Therefore, the reserves of the different energy sources display the same dynamics as reserves of non-fuel minerals, increasing steadily over time as a result of new exploration, technological advances, changing economic conditions and, not least, the policies pursued by mining companies.

#### The balances for selected energy sources

Table 30 summarizes the relationship between demand and supply for coal, crude petroleum and natural gas for the years 1980-2000. The first column gives the cumulative consumption over the period, and the second the current estimate of reserves, with both being world totals. At these levels the year of exhaustion can be estimated. It can be seen that crude petroleum and natural gas reserves are sufficient to the year 2000, but not for much longer, while coal reserves would not be exhausted (at the growth rates assumed for the period 1980-2000) until the year 2049. The initial indications are thus that these conventional energy sources would not be exhausted by 2000, even at the high growth rates necessary to reach the Lima target which is embodied in the scenario.

Table 31 treats the time period from 2000 to 2025 in a different manner. Here the assumption is that consumption will depend on the use of resources, rather than reserves, with all the accompanying technological change necessary for exploitation. The consumption growth rates are determined by the GDP growth rates of the scenario for the years 2000-2025, and cumulative consumption for this period is given in the first column of the table. Thus it can be seen that, if the presently estimated resources could indeed be used, they would be more than sufficient to sustain further growth of the world economy to the year 2025. Coal resources, for instance, would not be exhausted until the year 2113, while crude petroleum and natural gas resources would last until the years 2054 and 2041, respectively.

The initial conclusion therefore is that the present relationship between GDP and the consumption of three key energy sources is such that the high growths necessary to reach the Lima target would not lead to reserve exhaustion on a world-wide basis until after the year 2000; and further that a continued growth to the year 2025 would be possible if technological advance and other changes were such as to allow the use of known resources. The limited nature of this analysis should, however, be stressed: apart from the uncertainties of using existing consumption relationships for projections long into the future, the calculation of global balances between demand and supply for reserves says nothing about the regional balances, and new patterns of international trade, finance and co-operation could certainly be expected to be needed in order to achieve a harmonious exploitation of existing reserves. For resource use, in the later period up to 2025, it can be expected that to the need for international co-operation would be added the need for



Table 30. World reserve depletion to 2000  
(Millions tons of oil equivalent)

	Cumulative consumption 1980-2000	Current reserves	Consumption as percentage of reserves	Year of reserve exhaustion
Coal	60,986.6	538,688.7	11.3	2049
Crude petroleum	96,618.9	159,173.0	60.7	2008
Natural gas	36,808.3	66,265.7	55.5	2010



Table 31. World resource depletion to 2025  
(In 10<sup>3</sup> Million tons of oil equivalent)

	Cumulative consumption 2000-2025	Current resources	Consumption as percentage of resources	Year of resource exhaustion
Coal	165.0	6,000	3.0	2113
Crude petroleum	333.4	1,540	21.6	2054
Natural gas	119.0	280	42.5	2041



technological advance, if those resources at present known to exist were indeed to be systematically and economically exploited. A special consideration must be that the use by developing countries of so-called "frontier technologies" in this connection may lead to a new form of dependence on the developed countries.<sup>12/</sup>

### Other energy sources

The preceding paragraphs examined coal, oil and natural gas. Other energy sources have not yet been mentioned. Yet many are in use. Hydroelectric and nuclear fusion power are widely used. Biomass and solar energy are the subject of intensive research and development. Although results will be slow in coming, research in nuclear fusion as an energy source is intensive. At first sight therefore the rather reassuring conclusions of the previous paragraphs can only be reinforced by a consideration of other reserves and resources of these other types of energy. Table 32, which shows the potential of some renewable energy sources, is reproduced from the earlier study, and, as was there pointed out, in principle the energy supply potential of the world is sufficient to sustain levels of energy demand for growth into the next century. It was also noted that currently known technically recoverable uranium resources alone could support world energy demand over several hundred years, assuming of course that the energy use system is adjusted with the aid of technological development to use the mostly electrical power thus generated.

Accordingly, it is the more immediate depletion of oil reserves that will lead to problems, but it should be recognized that they are problems of conversion to alternative sources. These are problems for the developing countries in particular, since they are not technologically advanced enough to make the transition easily, and increased technical assistance in the relevant fields is essential. In this context, UNIDO has identified <sup>13/</sup> biomass and hydropower as the more immediately appropriate sources. The experience of Latin America in both these areas, and China (not considered in the present study) in the latter is found to be encouraging, and may thus be valuable to other, less advanced developing regions.

### Summary

The present paper is a revised and amended version of the previous study on industrial carrying capacity. Like its predecessor it has attempted to contribute to the more general study of the earth's carrying capacity by looking at:

(a) The role of industrialization at the world level in overall development for the future;

(b) The extent to which this contributes to the alleviation of socio-economic problems by increasing income levels and employment;



Table 32. Potential of renewable world energy sources  
(Million tons of oil equivalent per year)

	Technical potential	Realizable potential
Biomass	4,300	3,650
Hydropower	2,150	1,070
Wind energy	2,150	720
Geothermal (wet)	1,530	720
Solar (soft) <u>b/</u>	3,580	640
OTEC <u>c/</u>	720	360
Tidal energy	30	--
Wave energy		
Ocean current	4	--
Total (approx.)	14,460	7,160 <u>a/</u>
Solar (hard) <u>d/</u>	35,800-71,600	25,060
Total		32,220

Source: International Institute for Applied Systems Analysis (IIASA), Energy in a Finite World (Cambridge, Ballinger, 1981); World Energy Conference, World Energy Resources, 1985-2020 (New York, IDC Science and Technology Press, 1978).

a/ The total of 7,160 million tons of oil equivalent (MTOE) realizable potential consists of a large portion of energy in the form of electricity (secondary energy) and corresponds therefore to over 10,000 MTOE in primary energy requirements.

b/ User-oriented solar (collector) technology in small units. Extrapolation of a study of California to a world study results in a realizable potential of 1,580 MTOE/year.

c/ Ocean thermal energy conversion.

d/ Industrial use of solar energy mainly by solar concentrator technology.



(c) The extent to which natural resources (in the form of key minerals and of energy sources) will be available to sustain such industrialization and overall growth.

The study used new economic data, new estimates of resource availability and a different approach to the measurement of resources consumption. However, the same conclusions are found broadly to stand:

(a) Although the developing countries out-perform the developed in terms of GDP growth, the gap in GDP per capita between developed and developing countries will narrow only slightly, and special efforts will be necessary for the developing countries to achieve adequate levels of development. In 1980 the GDP per capita of developing countries was just over 10 per cent of that of the developed, but in the year 2025 this figure will be still less than 19 per cent.

(b) Analysis of the development of labour productivity and the world employment potential shows that, in principle, rapidly increasing labour forces could be productively employed. Relatively high growth rates of labour productivity were used, based upon its development since 1960, and in some cases, rates even higher than these. The balances at a world regional rather than a global level, however, indicate potential problems, implying either increased migration or, more rationally, a further reallocation of productive capacity in the future.

(c) Examination of seven important non-fuel minerals reveals that even very high consumption growth rates will not lead to resource exhaustion in the period. There thus is sufficient time between now and 2025 to develop both further (alternative) mineral resources and new substitutes.

(d) Although energy resources in total are so enormous as to present no theoretical obstacle to growth, in practice some conventional primary energy sources will be depleted very rapidly, given current trends in energy consumption and additional demands originating from the industrialization of the developing countries. There is thus a need for transition to new patterns of energy demand and supply, especially for the replacement of oil.

Overall it can be seen that there are enormous implications in terms of technological development and investment decisions, and more generally a new spirit of international co-operation for development, if the theoretically soluble problems of sustained growth for the industrialization of developing countries are to present no obstacle in practice. Without such a spirit, the regional imbalances in resources will lead to a slowing down and indeed to the stagnation of world progress.

#### Notes

1/ An abridged version was published in Industry and Development, No. 6 (December 1981) (United Nations publication, Sales No. E.81.II.B.4).



2/ See "Modelling the attainment of the Lima target: the LIDO model", Industry and Development, No. 6 (December 1961) (United Nations publication, Sales No. E.81.II.B.4).

3/ World Population Prospects as Assessed in 1980, (United Nations publication, Sales No. E.81.XIII.8).

4/ Centrally planned Asia is excluded.

5/ International Development Strategy for the Third United Nations Development Decade. (General Assembly resolution 35/56, annex), Official Records of the General Assembly, Thirty-fifth session, Supplement No. 48 (A/35/48).

6/ The International Development Strategy contains a (rounded) target of 4 per cent.

7/ Medium projections derived from World Population Prospects...

8/ The assumptions on elasticities and growth rates are based on those in the earlier study, which distinguished between developed market and centrally planned economies.

9/ See UNIDO, "Industrial carrying capacity and the Lima Target", Industry and Development, No. 6 (December 1981) (United Nations publication, Sales No. E.81.II.B.4), and G.J.S. Govett and M.N. Govett, "The concept and measurement of mineral reserves and resources", Resources Policy (September 1974).

10/ See United States Bureau of Mines, Mineral Facts and Problems (Washington, D.C., United States Printing Office, 1980).

11/ 1981 Yearbook of World Energy Statistics (United Nations publication, Sales No. E/F.82.XVII.16).

12/ "Energy development and industrialization" (UNIDO/OED.135).

13/ Ibid.







G. Interrelationships between population, resources,  
environment and development

United Nations\*

The need for studies with a holistic approach on a scale  
useful for regional planning

The need for population/environment studies

The tendency to deal with population increase as a self-contained problem now seems outdated. During the last decade, it was widely recognized that a country's population problem was not only a question of high fertility, but also one of nutrition, security in old age, the status of women, economic conditions and so on. Moreover, population growth is no longer seen as the only concern. Often more critical are problems linked with massive migration flows, such as the concentration of the world's population in urban areas not prepared for this afflux.

It is also now generally recognized that there are complex systems relations among population dynamics, the availability and use of natural resources (mainly connected with the state of agriculture), problems of the environment and economic development in general in any given geographical unit, both on a national and a global level. Knowledge of these interrelationships is still woefully insufficient. Only highly aggregated and simplified global and regional models have been put forward relating population to resource availability, environmental carrying capacity and development.

The limitations of global synthesis are obvious. The population/resource/environment situation differs from country to country and varies even from area to area within most countries, in particular the larger ones. The problems of assessing population/resource ratios, and of defining measures for their beneficial adjustment, must be tackled on a disaggregated national and areal basis. In fact, there seems to be a need for almost every country to develop a population/resource/environment model for its particular national situation and for its major geographical subdivisions.

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\* United Nations Educational, Scientific and Cultural Organization.



What seems certain is that these exercises of analysis and inventory-taking at the national level will underline global resource interdependencies that have developed over the last century and which have intensified over the last decades. The population carrying capacity of an area is no longer directly related to its capacity for food production. The situation has evolved in a direction that often makes a country's capacity and "elasticity" to integrate in global and continental economic exchanges the decisive variable of its population carrying capacity at aspired levels of welfare. Much still needs to be done to ensure that the benefits of this global interdependency shall be more equally distributed, and that small systems that integrate into larger ones shall not lose their capacity for self-reliance and endogenous development.

The wide recognition of the importance of endogenous development makes it more important than ever to bring about more rational management of indigenous natural resources in developing countries. It seems paradoxical that in many developing countries these resources are not used optimally, although imports of food have to be increased year by year owing to population growth and urbanization.

Not only is knowledge of population, resources, environment and development interactions still grossly insufficient, but there is a lack of methodological tools to describe and measure such interactions and to influence them through integrated policy-making and programming. National population policies and programmes operate with notions such as overpopulation and underpopulation. What is the yardstick for considering a particular country or area as overpopulated and another as underpopulated? How do we estimate population carrying capacities in a primarily rural economy or even in a multisectoral economy? There are many methodological questions, and not enough knowledge to answer them. In particular, research workers, planners and decision-makers lack advice on an integrated analytical approach to the study of these interrelationships and on the formulation and implementation of relevant integrated policies and programmes at the national and international level.

The United Nations World Population Conference of 1974 was aware of this situation and included as one of the objectives of the World Population Plan of Action:

"To advance national and international understanding of the complex relations among the problems of population, resources, environment and development, and to promote a unified analytical approach to the study of these interrelationships and to relevant policies" (paragraph 15d)

Among the recommendations of the Conference, paragraph 78 stresses the high priority given to research activities on population problems in this Plan of Action. Point (n) of paragraph 78 is concerned with the following research area:

"The interrelations of population trends and conditions and other social and economic variables, in particular the availability of human resources, food and natural resources, the quality of the environment, the need for health, education, employment, welfare, housing and other social services and amenities."



Given this awareness and mandate, the United Nations Fund for Population Activities (UNFPA) has extended the scope of its research programmes in this field.

### The MAB approach

Within the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Man and the Biosphere (MAB) Programme offered an ideal framework for pilot projects to study, at a micro-scale, the complicated interrelationships existing between the population problems of an area and its developmental and environmental problems. In fact, one of the underlying reasons for the launching of MAB was the evidence that the pressures of population growth and movement and the demands of development had placed stress on man/environment relationships. These pressures and demands have important consequences for the environment as such, but more particularly for the sustained capacity of the different ecological regions of the world to support human populations at desired levels of welfare and well-being.

The essential integrating approach to such problems is found in the concept of a man/environment system, in which emphasis is placed on the chains of interconnection between the environment itself, its usage, the society which it supports and the objectives of this society. In order to understand the functioning of this system, these chains of interconnection need to be traced out, "modelled", and wherever possible measured. One measure of particular interest in this respect is the capacity of a system to support people at particular levels of prosperity and well-being, and to support the very process of socio-economic development in its variety of forms. The concept of alternative uses of human and natural resources, and of guidelines to aid choice in decision-making, arise out of this approach. Strategies for natural resources use should aim to achieve forms of sustained production which combine optimal economic results with long-term ecological stability.

The man/environment systems of large countries are immensely diverse and complex and at present stage of integrated ecological research it would be extremely difficult, if not impossible, to develop a complete model of such systems. If, therefore, holistic approaches to the comprehensive study of complex man/environment systems are to succeed, examples of these systems must be found that are small, easily modelled and at the same time representative of larger systems. Islands appear to fulfil these conditions. They are bounded systems within and between which the interrelation of forces can be readily identified. Input and output of islands can be measured rather easily.

With this overall background, UNFPA, UNESCO-MAB and the Government of Fiji joined efforts to carry out a first pilot project on population-resources-environment interrelations in the eastern islands of Fiji (1974-1977). The main aims were to reduce gaps in existing knowledge, to elaborate a set of reference information and guidelines for planners, decision-makers and research workers, and to develop further the methodological tools needed for tackling problems in this field.



The results of this project are mainly of interest to tropical island states and those concerned with research and development in these countries. It is hoped, however, that the approaches and methods developed will prove of wider interest - to those dealing with population/environment relations in rural settings in developing countries in general, as well as to persons in all regions seeking insights for integrated planning and programming in the fields of population, natural resources, development and environment.

In the light of the Fiji experience, the collaboration of UNFPA and UNESCO has continued with the implementation of a second-stage project on population, development and environment interactions in the eastern Caribbean (1979-1981). The project had the active collaboration of the Institute of Social and Economic Research (ISER) of the University of the West Indies, in particular its Barbados branch. Studies were conducted in several of the islands, including Barbados, Saint Lucia, St. Kitts, Nevis, Anguilla and Saint Vincent. The basic methodologies developed in the Fiji project to deal with a relatively simple man/environment system were further developed to deal with much more complex situations of population pressure, migration, competition for scarce natural resources, the collapse of certain branches of agriculture due to the problem of diversion of labour inputs from agriculture into tourism, construction and other activities, strong external socio-economic impact and in some places environmental degradation.

### Outlook

The two MAB pilot projects can be considered as two successful efforts which advanced knowledge and methodology in general and provided the necessary data and information for integrated planning in the areas studied. However, the urgent task of building up a vast programme of similar studies covering an array representative of the major environmental and development conditions in the third world needs still to be tackled.

### Population, resources and the environment: new requirements for development planning

One of the basic issues associated with the question of population/resource/environment relationships is how to plan for a future in which requirements of populations (and in particular growing populations) can be met on a sustainable basis.

This is not an issue that is readily tackled by traditional methods of development planning, largely because such methods have not been evolved to deal with questions having long-term implications or cutting across sectoral boundaries. Many countries are, however, showing concern about this problem. The Declaration of the 1981 Conference of Asian Parliamentarians on Population and Development, for example, calls on the countries of that region "to adopt an approach which will ensure the appropriate integration of resources and population in the formulation of their development policies and programmes".



The task of evolving such an approach requires the addition of a further element to the population/resource/environment group of relationships, that is, level of well-being, for it is population in combination with levels of well-being that in the first place determines resource use and the burden on the environment. It also requires taking into account a number of other factors that have only just begun to penetrate political thinking.

#### Adoption of long-term time horizons

Reality tends to be seen as the current economic situation with the future something that can be coped with as it arrives. The challenge is to conceive of society as a wider entity than simply the individuals alive at any one particular time. As noted by the United Nations Administrative Committee on Co-ordination Task Force on Long-term Development Objectives,<sup>1/</sup> referring in this particular case to energy, "...the inclination to make decisions incrementally, a preoccupation with immediate problems and the need for "crisis management" all lead to a discounting of long-term benefits ...". When a long-term time horizon is adopted it allows one to focus on anticipated problems which must be currently faced and which cannot be postponed to a time when action may be too late or prohibitively expensive. It makes possible the avoidance of ad hoc policies of expediency which in the long run may be self-defeating.

Planning for a longer range future provides for action which may not be justifiable or which may appear superfluous in the context of short-term planning. Such action includes:

(a) The allocation of heavy initial investments which are required, for example, in order to build up the infrastructure necessary for ensuring a sustainable energy system or to provide for ecological stability - something easily discounted by traditional accounting methods;

(b) The husbanding of natural resources in such a way as to ensure the sustainable productive capacity of renewable resources and to plan for the rate of exploitation of non-renewables in a manner allowing for the availability of substitutes and giving time for social adjustment;

(c) The formulation of social goals that accord with long-term prospects of physical development;

(d) The setting of population growth and distribution targets so that they accord with a nation's capacity for sustainable development.

(e) The planning of research and development to meet problems identified in advance and taking account of necessary lead times;

(f) The need to conceive and implement appropriate educational and communication programmes that will enable people to acquire greater awareness and understanding of the national situation and to support population and other policies designed to secure a satisfactory life for their children and grandchildren.



### Development of integrative approaches

It has been aptly remarked that one has to think of the situation as a whole in order to act relevantly in any part of it. The interactions between different trends and between separate sectoral policies are numerous and complex and the effects may appear in unexpected ways and at unexpected times.

An individual demographer, agronomist, engineer or economist may know in theory that his particular field of activity is not independent of the others; but in practice he may not always accept this. An economist, for example, may be convinced that adequate financial investment will bring a quick solution to the problem of energy supply, whereas it is the energy expert who knows what the physical reality of the situation is. One of the problems the Global 2000 Report came up against was that most of the individual projections for the various sectors studied - food, minerals, energy etc. - assumed that sufficient capital, energy, water and land would be available in each of these sectors to meet their needs, regardless of the competing needs of the other sectors.

Much of the problem lies in the nature of government institutions which with their vertical ministerial structures are still on the whole ill-equipped to handle problems that cut across sectoral boundaries, to encourage interdisciplinary thinking or to conceive situations in their entirety. Many changes will have to be made before truly integrative planning becomes a regular part of government activity.

### The importance of socio-cultural factors

Despite the lip service paid to them, socio-cultural factors have tended to take second place in development planning. In attempting to identify options for sustainable development the consideration of cultural factors becomes vital. This implies an understanding of how human factors enhance resource use or otherwise. It implies in particular clear definitions of social objectives and of their implications for resources demand. A level of existence that is physically possible may not be socially acceptable. A society may attribute greater importance to avoiding situations of crowding and retaining wilderness area than to increasing its physical consumption beyond a certain level. Development options open to two societies with identical resource endowments will never be the same.

It is equally true that physical circumstances influence a country's societal evolution. The goals of endogenous development, for example, need to reflect this fact. Certain cultural values such as having a large family or requiring high consumption levels may have to be modified in the wider interests of the society. Current efforts to investigate the implications of "alternative life-styles" are to be encouraged and could usefully be incorporated into efforts to plan for sustainable development.



### Considerations of a conceptual and methodological nature

The concept of carrying capacity can provide a useful point of departure in attempting to understand and quantify population/resource/environment-level of welfare relationships considered in the context of planning for sustainable development.

Carrying capacity expresses the level of population that may be supported by a country at a given level of welfare. More precisely it may be defined as the number of persons sharing a given territory who can, for the foreseeable future, sustain a given physical standard of living, utilizing energy and other resources (including land, air, water and minerals) as well as enterprise, skills and organizations. This interpretation is far from the rigid notion of a static population/food relationship. Carrying capacity as understood here is rather a dynamic concept which may be extended (or restricted) in numerous ways: through changes in cultural values, technological discoveries, improvements in agricultural husbandry or land-tenure systems, changes in education systems, modifications of fiscal and legal arrangements, discoveries of new mineral sources, or the emergence of a new political will. There is never only one solution to the population/natural resource equation, for it is not population alone that determines the pressure on resources (and potential associated ecological effects) but also individual consumption which in turn is determined by value systems and perceptions of life style. Whatever a country's situation, potential, or outcomes selected, if carrying capacity can be clarified, it can offer a useful means of helping politicians shape the future of their societies.

In the assessment of national carrying capacity, factors external to the system cannot, of course, be ignored. These include the total world supply of resources (in particular energy), world population growth, migration, the global environmental situation, climatic change and war. Were a world Government to exist or were the new international order a reality, it might not be necessary to consider the carrying capacities of individual States - but that is a hypothetical situation.

One of the trickiest methodological problems confronting those concerned with quantifying carrying capacity is to find a common numéraire through which the different elements may be related.

A natural reaction is to turn to money; but money is no true indicator of the real value of physical endowments or of impending constraints. It was, of course, a political event that brought the oil crisis into view and drastically raised prices. Even apart from the question of natural resources the traditional market forces of supply and demand are no longer the only considerations reflecting the price of a given commodity. Multinational corporations, with their flexibility of action across different enterprises and different countries, are able to fix prices independently of conditions prevailing in any particular locality or economic sector. Social considerations sometimes complicate the problem of ensuring that wage increases shall be consistent with rises in productivity. Then there is the question of environmental costs which have tended to be externalized in



economic planning but which will need in the future to be taken more seriously into account. Money alone is an insufficient currency when dealing with trends that are essentially long-term. An alternative measure needs to be found.

UNESCO, which is working on the assessment of carrying capacity, is developing an approach that uses energy (vital to every aspect of the economy) as a common denominator to link output to input within different economic sectors, including agriculture, industry, infrastructure transport and energy supply systems - with consideration of employment and educational priorities and other factors of a socio-cultural nature. Investigations are underway in a number of developing countries and plans are being made to link the work of UNESCO with that of FAO on the carrying capacity of lands in the context of given national situations.

#### Notes

1/ International Development: 1981 - Critical Policy Issues. A study by the Task Force on Long-term Development Objectives of the Administrative Committee on Co-ordination, United Nations, 1981.



#### IV. SOCIAL AND ECONOMIC DEVELOPMENT

##### A. Population, resources and environment and prospects for socio-economic development

Mahar Mangahas\*

##### Prospects for demographic equilibrium

This paper discusses the prospective impact of population growth, within the context of global constraints on resources and the environment, on certain basic conditions of socio-economic development - namely, food, education, health, housing and the distribution of income. It thus involves several areas of study, each of which has its own specialists whose views must be carefully considered and integrated, as well as a generalist can, into some unified picture of future socio-economic development.<sup>1/</sup>

Table 1 presents a basic summary of world demographic conditions as of 1980. About three fourths of the world population of 4.4 billion is in the less developed countries. The population of these countries is growing at an annual rate of about three and one half times that of the more developed countries. Compared to the latter, the LDCs' birth rate is more than double, and its total fertility rate is nearly two and one half times as large. The gap in life expectancy is more than 19 years for males and more than 15 years for females. The dependency rate in the South is dominated by the youth, who are 39 per cent of the population, compared with only 23 per cent in the North. On the other hand, the aged are 11 per cent in the North but only 4 per cent in the South; thus the total youth plus aged dependency rates are about the same for both groups.

Up to the 1960s, the population of the world had been steadily accelerating for many centuries. The world population would have been 7.3 billion by the year 2000 if the demographic trends of the 1950s had been maintained (Salas, 1982). There was even one extrapolation to an infinite population in 2026, when everyone would be squeezed to death on doomsday. However, the growth rate reached a peak of 2 per cent per year in 1965 or so. By 1975-1980, the growth rate was 1.72 per cent per year, or back to where it was in the period 1950-1955 (1.76 per cent per year; see Salas, 1982).

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\*Vice-President, Research for Development Department, Development Academy of the Philippines, Manila.



Table 1. Basic world demographic data, 1980

	More developed <sup>a/</sup>	Less developed <sup>a/</sup>	World
Population in billions, 1980	1.1	3.3	4.4
Life expectancy at birth in years 1975-1980			
Females	75.5	56.2	58.9
Males	68.3	54.0	56.0
Total fertility rate, 1975-1980	2.0	4.8	4.0
Birth rate per 1,000, 1975-1980	15.6	34.3	29.4
Death rate per 1,000, 1975-1980	9.4	12.2	11.5
Natural increase (% per year) 1975-1980	0.6	2.2	1.8
Age distribution, 1980			
% aged 0-14	23.0	39.1	35.1
% aged 65+	11.4	3.9	5.8

Source: Tomas Frejka, World Population Growth Prospects (New York, The Population Council, June 1981).

<sup>a/</sup> More developed includes North America, Japan, Europe, Australia, New Zealand and the USSR. Less developed includes all others.



The genuineness of the new phase of decelerating growth is supported by the results of the World Fertility Surveys in 15 developing countries over the period 1974-1977, which shows dramatically declining fertility in many areas, a rising age at marriage in some (Asian) areas, and that half of the married women of reproductive age desire no more children.

The most conspicuous reason for population acceleration, in the last decades before the growth peak, was the great down trend in mortality. The mortality trend was not recognized the United Nations for 10 years, according to Kuznets,<sup>2/</sup> even though it was more dramatic than the mortality declines in the advanced countries in the late eighteenth and early nineteenth centuries. The recent declines in mortality in the LDCs have been due not only to technological advances but also to socio-economic and institutional changes.<sup>3/</sup> The new conditions in mortality would expectedly lead to declines in fertility as well, Kuznets argues, and the response in fertility did come, but with some delay. The United Nations was also slow to sense the changes in fertility; as late as 1975 it was estimating 1970-1975 growth as 1.9 per cent per year and projecting 1975-1980 growth almost 2 per cent per year. By 1977, however, it was already clear that the world population had decelerated back to the growth rate of the 1950s.

Frejka's brief history of population projections (March 1981) also indicates that demographers had failed to anticipate the turning point in the rate of population growth. It is now known, however, that many countries have already passed the turning point, including such large ones as China and India, and several developed countries are already below the replacement level fertility. According to Demeny (January 1981), the present phase of world deceleration is a safe expectation for the next 50 years. Thus, there now appears to be a new mode of extrapolation, namely, that every country reaches a turning point at some stage, after which growth steadily decelerates until a point of zero population growth, when the population stabilizes.

Demographers are in strong agreement that there will still be a considerable population growth, due to the large proportion of women in the child-bearing ages. Even after reaching the replacement level of fertility (one new female per woman of child-bearing age), the momentum exists for increasing a country's population by another 30 per cent.<sup>4/</sup>

The population of the world grew from 1.6 billion in 1900 to 4.4 billion in 1980. From the present level, the prospect seems to be that it could eventually double. According to Frejka (June 1981), who asserts that his projections' lower and upper limits are firm on account of the unlikely and limiting nature of the assumptions used, the expected maximum range for a stable population is 7 to 13 billion, and this is attainable within the twenty-first century. He also suggests that a narrower and more plausible expected range is from 5.9 to 6.2 billion by the year 2000 and from 8.5 to 10.6 billion by the year 2100; these ranges assume that replacement level fertility will be reached sometime between 2000 and 2025. The plausible range for the annual rate of world population growth in 2000 is 1.0 to 1.5 per cent; and for the less developed world in particular it is 1.1 to 1.8 per cent.



The United Nations projection of 6.1 billion in the year 2000 is squarely within Frejka's range. However, the United Nations projected growth rate by 2000 is placed at 1.5 per cent per year, and the projected stable population level is 10.5 billion, to be attained in 2110 (Salas, 1981), or in the upper end of Frejka's range. The projection of the United States of America in the Global 2000 Report is 6.3 billion in 2000, stabilizing at 12.2 billion late in the twenty-first century. But this could be reduced to 5.8 billion in 2000 and a stable level of 8 billion, according to the United States Council on Environmental Quality (1981), if the availability and use of family planning devices in the developing countries could double by 1990.

Thus, even with the universal acceptance among demographers of the pattern of decelerating growth, the ranges among long-term projections of population are still very wide. The projection models that are being used are still relatively crude, in the sense that they take little account of the implications for demographic variables of alternative patterns of economic, social, political, technological and environmental development. The Club of Rome model, which stands out for its heroic attempts to integrate such factors with population, tends to be regarded by demographers as ambitious and lacking in empirical background (Frejka, March 1981; and Tabah, 1975). The "global modellers", on the other hand, assert that the use of judgemental global parameters for certain posited relationships is preferable to ignoring such relationships completely (Richardson, 1982).

The importance of socio-economic relationships in determining demographic change has been well accepted at high policy levels. For instance, the United Nations Fund for Population Activities (UNFPA) has called for increases in women's education and work status, increased access to health and family planning designed with community participation, and the development of more progressive attitudes towards family formation (Sales 1982). But while such views may already have become conventional, what is not yet conventional is their systematic incorporation in the population projections.<sup>5/</sup> Demographers' projections, Frejka admits, are still a blend of demographic knowledge and intuition (March 1981). Demeny has remarked (July 1981):

"Given the present unsatisfactory state of theorizing about the socio-economic determinants of fertility, it is neither surprising nor to be deplored that predictions of future fertility trends... make no reference to any specific expected socio-economic evolution..."

Thus, while it has been more or less well established that population size and structure are crucial factors for development <sup>6/</sup>, the state of the art of forecasting long-term demographic change is still in need of substantial improvement. In a discussion of future prospects for population, resources and social well-being, in particular, it should not be assumed that the uncertainties lie preponderantly on the side of the earth's resources, whereas the predeterminable trends or givens lie heavily on the side of population. Much of the population side is also unknown.

In order to define future population trends more accurately and meaningfully, further studies may be recommended in (a) the process of family/household decision-making and (b) the implications of socio-economic



inequality for demographic changes. It is the family - not only mothers but also fathers and those of the older generation - that makes decisions affecting life, death, succession, training, work etc. The decision-making context of this group may be very different from that of the individual.<sup>7/</sup>

At any point in time, there are differentials in mortality, fertility, nuptiality, migration etc. according to socio-economic status. There is an entire distribution of demographic parameters among the population, depending on the socio-economic distribution, rather than a single parameter. The question is, what is the distribution among socio-economic classes of the changes over time in, say, fertility? Will differentials in fertility widen first and then narrow later, Kuznets asks (in obvious reference to his thesis of income inequality typically growing worse before it becomes better)?<sup>8/</sup>

In projecting 50 years ahead, one has to look at least 50 years back. From such a perspective, the demographic paths that have been taken by say China, Sri Lanka, or Taiwan, Province of China, cannot be regarded as independent of their political histories and of the resulting changes in socio-economic inequalities. Neither can the long-term population futures of say Africa or Latin America be accurately assessed without realistic scenarios of possible revolutions or reforms in these regions over the next one or two generations.

#### Problems of food, resources and the environment

The problem of hunger and undernutrition is very serious, even at present, and continued population growth only makes the job of coping with it more difficult over time. According to the United States Presidential Commission on World Hunger (1980), one out of every eight persons in the world is malnourished, and the number is rising.<sup>9/</sup> The root cause of undernutrition is poverty; this view is unanimous.<sup>10/</sup>

The rate of growth of food production has been slightly above that of population. The influence of population growth on food demand has been far greater than that of income growth. But this is partly due to the lack of much change in income structure in many areas, and there is still a substantial potential for income-induced demand among the poor.<sup>11/</sup> The fact that two fifths of cereals produced are used as feed and indirectly consumed as meat by upper-income groups is an indicator of the great inequality in the consumption of food.

New sources of growth in food supply do not portend to be as readily available as before. The fish catch has already reached a peak, and has to be cut back because the present rate is unsustainable.<sup>12/</sup> Very little new agricultural land can be found, especially since the United States land reserve has already been put back into production. The growth in food supply will have to be drawn essentially from increases in yield per hectare. The growth in grain yield was fairly substantial over the period 1950-1970, at 2.2 per cent per year, but it decelerated to 1.5 per cent per year over the period 1970-1980 (Brown, 1981). At the same time, the carrying capacity of the land has been endangered by numerous factors, including erosion, desertification,



shortening of fallow periods, use of organic matter as fuel instead of as fertilizer etc. Studies such as the Global 2000 Report have sounded warnings of depletion of genetic resources due to the disappearance of forests, of over-concentration of carbon dioxide in the atmosphere, and of depletion of the ozone layer. The problems of chemical pollution and of possible changes in the weather are important unresolved issues.

There is a wide range of views regarding the future food situation. It is arguable that the relative price of food will tend to rise, not only due to the greater scarcity of natural resources, but also due to a rising real cost of energy and possible declines in the physical returns to fertilizer. The question is whether these can be offset by technological advances, as well as by the social and institutional reforms that may be needed in order that the technological potential shall be substantially reached.

The Global 2000 Report, in particular, is highly pessimistic, warning that the real price of food will rise in all regions and could double by the year 2000.<sup>13/</sup> Lester Brown (1981) focuses on the volatility of food prices, recalling the doubling that occurred after the Soviet wheat purchases of 1972. With world reserve stocks of grain at only 40 days' consumption by his estimates, he calls for drastic measures to decelerate the population so that a stabilization is attained by the year 2020 at a level of only 6 billion.

There are also the guardedly optimistic views. The global models of Leontief (1977) and MOIRA (Linnemann, 1979) both regard the food productivity increases needed over the next generation to be technologically feasible. Drawing from a review of studies on resources for the future at the global level and for Colombia, India, Indonesia, the Philippines and the United States, Ridker (1979) concludes that variations in assumptions regarding future population and income growth have smaller effects on the demands made on the resources and the environment compared with alternative scenarios regarding changes in technology, in recycling and in access to resources. He feels that the more extreme versions of the "running out" thesis are without basis, but warns against complacency in view of the general ignorance of the long-term effects of man's actions on the globe.

However, there are no disputes as to the urgent need to raise the productivity of land through agricultural research and through investments such as irrigation. These are bound to increase the real value of land, and land prices will thus rise in all alternative uses, whether food, fuel woods, building materials or paper. The value of water rights will likewise increase, with implications of danger of international conflicts. The factor of economic rent will thus gradually tend to dominate the issue, and the achievement of an equitable distribution of economic rent will be the main challenge facing the designers of new social and economic institutions.<sup>14/</sup> Ideology may well play a major role in this effort.

International trade is another important factor. Food deficits have been, thus far, essentially trade deficits; land and water, though globally adequate, are not distributed in proportion to the population. International borders must be crossed by food and people. The pattern of food trade has reversed: whereas 50 years ago the LDCs were the net food exporters, at



present they are net importers, and North America has the dominant export position. Instances of the political manipulation of food trade may tend to be remembered for generations. The establishment of an orderly system of food trade or transfers, viable in times of emergencies, is another important task on the institutional agenda.

Finally, how are the world's poor going to have adequate access to the food? Can the future patterns of food consumption of the affluent countries and the patterns of sharing in income growth in the poor countries be managed so that the present gross inequalities in food access are meaningfully narrowed? Again, the issues of social and political feasibility come to the fore.

### Education, health and housing as home investment sectors

In traditional development economics, which is subtly and effectively defended by present national income accounting systems, the term "investments" is reserved for long-lived material sources of income streams. Housing is part of the measured capital stock, and newly constructed dwellings are part of measured investment. But education and health are not treated in the same way, except for the physical facilities (which are not found in the home); the recurrent expenditures, which are the major portion of annual costs, are recorded as merely "consumed services".

With such a limited focus, the implications of future demographic changes for education, health and housing (EHH) cannot be adequately discerned. Obviously, EHH are very important components of the long-term resources, or capital in the full sense, both human and material, of the home. Schools and hospitals are capital goods sectors in the sense that they help create and maintain human capital. However, families also participate in such creation and maintenance of better educated and healthier persons; and, ultimately, the home is the locus of EHH capital.

In some ways, current demographic trends will tend to improve the state of EHH capital. Parents will be able to afford schooling for their children more easily on account of later marriage (making for a better conjunction of schooling expenditures with the life cycle of income), wider spacing of children and fewer children. Lower fertility will make for lesser health risks particularly to mothers and infants. Parental resources per child for child care will tend to increase.

In the demographic transition, the proportion of the youth tends to increase, up to a point; then the working age population grows in relative dominance. In the meantime, as life expectancy extends, the proportion of the aged gradually grows in significance. The proportion of school-age children (5-14) in the LDCs seems to have passed its peak; Jones (1975c) has projected this at about 25 per cent for 1980 and 23 per cent by 2000.

From the standpoint of health care, the changing age structure implies a transition in relative importance of the functions of disease prevention, cure and care. The role played by the family in these functions is only



superficially suggested by the trends in aggregate youth dependency and aged dependency. The ratio between aggregate age groups do not capture the dependency structure within families as micro-systems of mutual support, independent of external, institutionalized social security.

The future trend in household (as distinct from family) size and structure is an important unknown factor, only partially related to the trend in fertility. Although the American norm of a two-child family does imply a typical four-person household, it does not follow that the Chinese norm of a one-child family will necessarily imply that the typical future Chinese household will consist of two parents and one child. Future household structures are likely to be highly dependent on housing, income and work opportunities, among other considerations. In poorer countries, often the most convenient way for better-off families to share their economic advantages with their poorer-off relatives is a transfer, not of income, but of persons; thus household size can be quite volatile, depending on economic conditions. In such areas, it may be realistic to expect the older generation to be living with their grown-up children; in developed countries, grandparents and parents may live apart but still feel very close in mutual support on account of the telephone and other swift means of communication and transportation.

Future household structure is by no means a given. Since this plays an important role in education (home learning), health (home care) and old-age security, it may be wrong to expect that the development of social institutions in the poorer countries should follow the pattern laid down by the richer ones. Families and households are probably adapting to the social and economic environment with as much sensitivity as the institutions adapt to apparent changes in demographic conditions. It may well be practical, in China, to promote extended family or multi-family living in traditional sized dwellings, instead of modifying existing dwellings to the socially prescribed family size.

The social concern for home capital in EHH stems from considerations of both productivity and equity. The concern for human productivity is already evident in the very use of the term "capital". The concern for equity is seen in the use of population-wide criteria of minimum needs, e.g., universal primary schooling or the WHO 1990 targets of safe drinking water for all and immunization of all children against main infectious diseases. The distribution of EHH home capital is obviously highly uneven, both between and within countries.<sup>15/</sup> As with food, poverty of the family is still a most important reason for inadequate access to sources of EHH capital.

The heavy government involvement in activities which produce the EHH capital for families is another manifestation of the social commitment to distributive equity. These activities are not necessarily done any more efficiently by the Government than by private enterprise; equity seems to be a higher objective than efficiency in this case. Furthermore, it may be misleading to refer to population control as saving government expenditures in EHH formation. More likely, the population control will induce Governments to spread EHH capital among more families or to invest more deeply in EHH per family, using the same resources.<sup>16/</sup>



The government participation in the EHH sectors would (a) possibly raise national investment in EHH to higher levels than would otherwise be the case, (b) deliver or allocate EHH among households according to some social equity criteria (presumably different from mere ability to pay), and (c) finance EHH through taxation or some other social option. There are obvious intentions to transform the existing socio-economic class structure into a more equitable one through fiscal redistribution of EHH investment benefits and costs. Much depends, therefore, on the socio-economic distribution of the specific populations to be served, viz., the class distributions of the school-aged, of the infirm aged, of the housing subsidy eligibles. This redistributive process is itself an important part of the ongoing socio-economic evolution which feeds back into the demographic processes.17/

As mentioned earlier, the socio-economic status characteristics of most demographic variables have not yet been adequately studied. This prevents either the demographic inputs into the social investment system or the indirect demographic consequences from being spelled out in much detail. Yet many pressing policy issues in the area of EHH are not well answered on scientific, as opposed to ideological grounds. Without such background information, issues such as the allocation of education investments among primary, secondary and tertiary levels;18/ quotas of educational entrants in conjunction with a screening system by examination; relative emphasis between the preventive and curative aspects in a health system; and the appropriate design (size/quality/amenities) and location of public housing.

The provision of education and health in the future will not be heavily constrained by physical resources and the environment, unlike food. Housing will be affected, however, to the extent that residential living areas become more congested (particularly in the gigantic urban areas), land values and rents increase, and traditional building materials become more expensive. In all sectors, ways and means must be found to tap the most plentiful resource, namely people. The increased use of para-professionals, and even those informally trained, in education as well as in health and the increased emphasis on people's participation in primary health care and in slum upgrading are examples in this line.19/

Thus, the home capital producing sectors are themselves heavily dependent on human resources or on human environmental factors. Although those born today may appear only 5, 12 and 16 years later in the elementary, secondary and tertiary school systems, they put pressures on the teacher-training systems almost immediately.20/ Thus, where the Government is heavily involved, from training of teachers and health personnel, to the operation of the school and health system, and finally to the employment of educated people, it takes on heavy responsibilities in manpower planning and development. The quality of teachers and of health personnel, the relative supply of white collar as against blue collar workers and the relative attractiveness of urban work as against rural work are all affected by the public sector's policies on hiring, compensation (both monetary and non-monetary) and promotion. If these policies are divorced from economic realities and are either too stringent or too generous 21/, serious problems can result.



Furthermore, country policies should not be made in isolation from the international scene. Manpower planning in the LDCs is complicated by the shifts in relative incomes across countries and the international migration, partly temporary and partly permanent, of health personnel, teachers and recently, even construction workers. The movements are probably much more severe than would be the case if domestic wage structures, particularly in the public sector, were less rigid in the face of new international developments.<sup>22/</sup>

In the case of housing in particular, the role of the people is heavily environmental. Aside from the mere number who need better housing and other amenities and the number who can be engaged in constructing these facilities, the future spatial concentration of work and other economic opportunities needs to be gauged. Cassen has concluded (1976, p. 814):

"It is nowadays reckoned that the main resources for the construction of dwelling facilities lie in the hands of the people themselves. Many demographers would admit that it is impossible to forecast a city population with any accuracy if it has been growing rapidly for sometime, so that the idea of basing an urban development plan on a relationship between known future size and required services may not be feasible. The task for urban planners thus becomes (or should become) far more a matter of devising institutions capable of responding to the future as it takes shape....."

In general, therefore, the problem of providing basic services for a still rapidly growing population could be made more manageable by focusing more on the human than on the material linkages between inputs and outputs, between the capital formers and the formed home capital. As before, a still useful answer to the Malthusian problem is that "with every mouth, God provides a pair of hands". The situation is only more complex: it is not that each people trade services among each other, in primitive economic fashion. Rather, the people must co-operate through a complex set of institutions, from the local community to the central Government, in order to finance, organize, allocate and deliver these services among themselves, in accordance with their social criteria.

#### Prospects for poverty and economic inequality

As stressed earlier, the most important reason for undernutrition and lack of access to basic home capital has been poverty. The data on world poverty are still quite crude. Table 2 summarizes estimates found in the recent World Development Reports of the World Bank. Using the 45th income percentile in India as the cut-off, the Bank has gauged poverty incidence in developing countries at 37 per cent in 1975, and at 33 per cent in 1980. Although the latter figure excludes China, the 1980 World Development report opines that the poverty incidence rate has generally declined <sup>23/</sup> but that the number absolutely poor has still increased due to population growth. The decline in poverty incidence has occurred in both fast-growth countries (Thailand, Yugoslavia) and in slow-growth countries (Costa Rica, Sri Lanka), and thus growth per se is not a controlling factor.



Table 2. Summary of World Bank projections of world poverty

<u>Date of World Development Report/reference countries</u>	<u>Reference year</u>	<u>Poverty incidence (%)</u>	<u>Number of absolute poor (millions)</u>
<u>1978</u>			
Low income	1975	52	630
Middle income	1975	<u>16</u>	<u>140</u>
		37	770
Low income	2000 base	27	540
Middle income	2000 base	<u>4</u>	<u>60</u>
		17	600
<u>1979</u>			
Low income	2000 low growth	26	520
Middle income	2000 low growth	<u>12</u>	<u>190</u>
		20	710
Low income	2000 base	22	440
Middle income	2000 base	<u>10</u>	<u>160</u>
		17	600
Low income	2000 high growth	17	340
Middle income	2000 high growth	<u>8</u>	<u>130</u>
		13	470
<u>1981 (excludes China)</u>			
Low income	1980	48	n.a.
Middle income	1980	<u>16</u>	<u>n.a.</u>
		33	750
Low income	2000 low growth	35	n.a.
Middle income	2000 low growth	<u>10</u>	<u>n.a.</u>
		24	850
Low income	2000 high growth	26	n.a.
Middle income	2000 high growth	<u>8</u>	<u>n.a.</u>
		18	630

Source: World Bank, World Development Reports.

Note: The poverty cut-off is the 45th income percentile in India; see Montek S. Ahluwalia, Nicholas G. Carter and Hollis B. Chenery, "Growth and poverty in developing countries", World Bank: Staff Working Paper No. 309 (revised), May 1979.



Although it recognizes that there are many exceptions to the Kuznets pattern of initially worsening and then narrowing inequality, the World Bank's basic projection procedures are based on this pattern (Ahluwalia, Carter and Chenery, 1979); the peak of inequality is placed at a per capita income of \$ 700 - \$ 900 (1978 values).<sup>24/</sup> For the year 2000, it projects a very wide incidence range of 13-20 per cent, involving 470-710 million people. The most recent projection for 2000, for developing countries excluding China, is a range of 18-24 per cent, involving 630-850 million people.

Obviously, rapid population growth helps to perpetuate poverty by restraining the growth of wages. The ILO has projected a world labour force growth of 55 per cent over the period 1975-2000, consisting of only 23 per cent growth in the richer countries versus 70 per cent in the poorer countries (cited in WHO, 1980), a factor that will tend to raise the international wages' gap. Demeny's projections of the population aged 20-39 (table 3) repeat this North-South pattern, and, moreover, project a marked change in the relationship between China and India. Whereas the growth of China's young labour force was formerly double that of India, over the next two decades it will be only two thirds that of the latter, making for a much more favourable potential growth in the returns to labour in China vis-a-vis India.

There has been a widening gap in per capita income not only between the richest and the poorest countries but also between the middle income and the poorest (table 4). The prospect is that it will widen further, despite more rapid relative growth in the poorer countries.<sup>25/</sup> Migration will thus increase, with the wage-pull factor adding to the ecological-push factor.

Apart from the labour force element, other demographic characteristics are much less significant. Although the life cycle of earnings will be modified by changes in the age structure, for instance, life-cycle income differences are generally not regarded as inequitable, for everyone takes his turn in getting older. In countries whose populations are getting relatively younger, the widening differentials in the supplies of labour across age groups will increase both the wage advantage and the employment advantage of the older groups,<sup>26/</sup> assuming that these are determined by market forces. It may be somewhat disadvantageous, economically speaking, to have been a baby-boom baby, but it is no more socially unjust than to have been born an Indian instead of a European. Poverty related to the life cycle is merely transitional; but those remaining in poverty throughout the cycle or even across generations are essentially in a poverty trap (Sirageldin, 1975).

Simultaneous with the pressure from the labour force will be the pressure on land and other natural resources. As discussed earlier, the efforts to raise the productivity of agricultural land, through both capital investments and biological improvements, may be expected to cause a long-term increase in the real rate of return from land. In the urban areas, on the other hand, the increasing congestion will have a similar effect on land. Thus, there would be a strong tendency for an ever-widening earnings gap between land and other factors of production. In order that reproducible capital and the human factor keep pace, according to market criteria, they, too, would have to be augmented by new technology and by new knowledge.



Table 3. Changes in the population aged 20-39  
(Millions)

	North	South		
		Total	China	India
Actual 1960-1980	58	360	116	68
Projected 1980-2000	17	600	92	142

Source: Paul Demeny, The North-South Income Gap: A Demographic Perspective (New York, The Population Council, January 1981).

Table 4. GNP per capita, index terms

Countries	1950	1960	1980
Industrialized	23.4	29.9	39.5
Middle income	3.8	4.6	6.2
Low income (base)	1.0	1.0	1.0

Source: World Bank, 1980 World Development Report, p. 34.



The capacity for technological change is, however, highly unevenly distributed internationally. Given the trends in factor endowments, innovations developed in the North are bound to be even more labour-saving and less relevant to the South than before.<sup>27/</sup> There is a need for more R & D to be initiated in the countries of the South, focusing on their own problems of productivity. This means that the South must develop its own top-level human expertise (as the Republic of Korea and Singapore have started to do) and/or acquire scientists from the North, in a reverse brain-drain, to work on R & D, not only in agricultural research centres, as is already taking place, but even in industrial research centres. Japan is an obvious example of a (formerly) labour-surplus and (still) natural resource-poor economy which has nevertheless attained international self-sufficiency after decades of investment in technological and managerial know-how.

It is recognized, even in the non-market economies, that it is the factors of production - land, labour and material capital - which earn, while it is people who claim those earnings, individually or collectively, according to certain institutional rules. Under the circumstances, the present highly unequal access of persons to land and material capital, coupled with the rule of absolute ownership and inviolability of prior inheritance cannot but lead to an ever-tightening concentration of wealth, income and power, and consequently to increasing social and political instability. We may expect, therefore, that the institutional rules will inevitably have to be modified, hopefully in an orderly manner, and sooner rather than later. Given a perspective of, say, 50 years even social institutions are endogenous and must seek the smoothest path towards equilibrium. The problem is that many market economies may not be well prepared for this.

This analysis stresses the role of basic factor endowments and of the existing distribution of ownership (or claims) over those factors among the people. These appear to be more vital for the long-term future than the traditional processes of accretion through savings or fragmentation through inheritance. If only the initial distribution were more even - with everyone owning a bit of land, a bit of material capital and his own human capital - then the accretion or fragmentation, since they are not inequitable processes in themselves, would not produce an inequitable result. Inequalities due to demographic differences, e.g., in number of children, would not be unfair, to the extent that the number of one's children could be a free choice; and so could savings, as against consumption, be a free choice. One may inquire, in fact, as to the extent to which the degree of present inequality is explained by the mere steady operation of the savings and inheritance processes in contrast with more marked institutional events such as the engagement/disengagement with colonialism, the abolition of slavery, or the allotment of public-sector natural resources to private enterprises. It is more likely the artificial, rather than the natural, inequalities that are at the root of inequity.

#### Policy implications and conclusions

The thesis that population growth tends to retard the growth in economic and social well-being is still well-accepted, even though the development



models in which demographic factors are purely exogenous, and in which economic growth hinges on material investment, are increasingly regarded as too simplistic. The indirect approaches aimed at fertility reduction, including the provision of basic services and better income opportunities for the poor, have begun to compete on more even terms with the direct approaches, including anti-natalist incentives packages and the dismantling of restrictions on sterilization and on abortion. This may be due, to some extent, to the realization that world population growth, while still fairly rapid, passed its peak one and a half decades ago and had decelerated to the growth rate three decades back. This appears to be more than could be attributed to family planning programmes of themselves, unsupported by other socio-economic changes.

The alleged advantages of population growth, meanwhile, are becoming increasingly implausible. If the justification is to achieve economies of scale in production, population growth is neither necessary nor desirable (Sirageldin, 1975); income growth may be as potent as population growth in raising demand, and international trade is a potential outlet in case domestic demand is still insufficient. There is no evidence that population growth is needed to stimulate food production growth in particular, according to Abercrombie (1975). Cassen (1976) concludes that there may be economies of scale in transport and in communications, but in health or education population size brings few if any economies. For poor countries with abundant labour, there seem to be no potential economic advantages from population growth.

In a fuller demographic development model, the size of the population helps to determine the demand for products and services in the economy, and is in turn affected by the amount of access it has to these goods. The population, augmented by its human capital and complemented by the non-human factors of production, also produces these goods, some directly and others indirectly through trade. The earnings of all of the factors of production, human and non-human, are distributed among the population in accordance with prevailing institutional rules concerning the determination of factor prices (whether centrally or through the market), property rights, taxation for some and subsidies for others, and the like, and these distributed incomes are the basis for access to the goods.

The burden of population growth is lessened through any means that raises factor productivity. One means would be the removal of conventions restricting the use of any factor below full capacity. For instance, could the schooling system allow the young more leeway to leave for work, without depriving them of the chance to return to school later; could the retirement age be more flexible upwards, in accordance with the rise in life expectancy; could working environments and schedules be adjusted to allow for more part-time jobs and more intermittent jobs, to lessen the inconvenience of mixing work with schooling, motherhood, or care for elderly members of the family?

Still other neglected means are those fundamentally connected to the human factor itself, as has been discussed earlier with respect to food, education, health and housing. Access to these items is being sharply



restricted by widespread poverty, which in turn is linked to the lack of access for the poor to land and other non-human factors. This implies a continuing need for non-superficial land reform, covering both private and public sources, and for other means of asset redistribution. In short, it implies a need for a basic reorientation of development managers away from macro-economic growth and towards distributive equity.

Unfortunately, the most basic management tool, namely information, has been sorely lacking. In the first place, the ubiquitous system of national accounts needs to be reformed in order to classify all the additions to home capital, through basic education, health and housing, as part of investment in the full sense, and to classify training for new teachers, health personnel etc. as part of the capital goods sector. Second, measurement activities that focus on the well-being of particular target groups, as is done in most social indicators systems, should be instituted and encouraged. Third, the new indicators should be incorporated into official development planning, targeting, project appraisal, monitoring and evaluation etc.28/

The function of the improved information systems would not be merely for better technical understanding of the problems. As important, perhaps even more important, would be the heightening of society's consciousness and appreciation of the problems, and of the directions in which social co-operation would be required. The political will to effect the needed institutional changes is often shaped as much from the views of the general public,29/ which are perceived by a politically keen leadership as from the special visions and talents found within the leadership itself. If the proffered new institutions have no historical precedent, how will the people react to them; will they actively participate in the implementation of what are essentially social experiments; will they persevere through the inevitable mistakes, modifications and re-modifications of the new approaches? Each Government must examine its society's views, and the international agencies, in turn, must discern what the Governments want.

When equity-oriented policies are concerned, social norms will have to play a critical role. The projects and measures for uplifting the poor will have to be financed by others; vested interests may have to be displaced. International policies must also contend with the people's senses of international morality, e.g., regarding the virtues of making certain donations, and regarding the dignity with which they can be received. Questions of morality are essentially resolved by the culture of the people, and not on any universally objective grounds. The proper role for technicians is to provide better data to the people, to enable them to make better-informed judgements, and to help in the systematic discernment of the social consensus.

Political change would have to be part of the long-term agenda. Any successful institutional rearrangement in favour of the poor would necessarily involve a tipping of the balance of political leverage towards them. It is difficult to classify the political change as cause or effect; perhaps both changes come together. Neither can one be confident that the changes will be gradual or reformist rather than sudden or revolutionary. In any case, it seems clear that the changes needed would be in the general direction of greater people's participation and greater democracy.



The same general direction would seem to apply in the area of international policy. The moves towards greater volumes of development assistance and long-term credits from the most developed countries to the LDCs and the reduction of international barriers to the exports of the LDCs - "experts" not only of goods but also of people themselves - are part of the processes by which a more stable international economic, and consequently political, order can evolve.

The need for orderly institutional changes is even more critical at the international level than at the national. Peaceful conditions are both a part of present world well-being and an important input for the well-being of the future.<sup>30/</sup> Invariably, the groups that have been commissioned to peer into the distant future have argued that measures to improve access to food and other basic necessities are highly effective means of promoting global security. Greater confidence in global security, in turn will, allow the release of substantial resources for world development. Again, the institutional relationships come full circle.

#### Notes

1/ To discern the outlines of a picture of such broad scope would be almost hopeless without the general reviews of population and development available in the survey article by Cassen (1976) and in the collections edited by Hauser (1979), Robinson (1975) and Tabah (1975).

2/ In Birdsall, et al., 1979. The section of this article concerning demographic puzzles was written by Kuznets.

3/ Sri Lanka is an often-used example of a poor country having a very high life expectancy on account of evenly distributed health services.

4/ Keyfitz, as cited in Cassen (1978).

5/ In the 1975-1977 research consortium on Population, Resources, Environment and the Philippine Future, the population projections were made by the demographers independently of the economists' projections of future conditions of health, education and the distribution of income. In formal workshops which were organized to contend with the issue of feedback from expected socio-economic conditions to demographic variables, the demographers insisted that their projection procedures had already made due allowance for expected socio-economic progress.

6/ Cassen's review of the literature concludes (p. 821):

"While some effects of population growth in developing countries have been exaggerated, especially the savings effect, there seem to be few convincing arguments disturbing the conclusions that rapid population growth slows down the improvement of average living standards."



7/ Kuznet's definition (in Birdsall, 1979): a family is a unit of co-operation in economic and demographic functions such as making a living and sharing it with dependants, producing and nurturing the next generation, and sheltering and sustaining the older generation past productive age. See also Demeny, July 1981.

8/ See Birdsall, 1979. This implies a need for demographic data categorized by within-country socio-economic status, since cross-country comparisons of averages will not be helpful. Much thought has to be given to the operational definition of socio-economic status; Sinha (1975), for instance, suggests grouping the propertied from the unpropertied.

9/ Also see the World Food Conference, cited in Linnemann, 1979.

10/ See Johnson (1976), Cassen (1976), Abercrombie (1975), Sen (1980), and the United States Hunger Commission (1980). The last reference asserts that "more food production must be subordinated to the goal of more equitable access for all".

11/ Abercrombie (1975) has noted rises in food demand in Chile following wage and agrarian reform. Ongoing studies of food demand differentiated by income group in Southeastern Asia, under the Rice Policy Project sponsored by the International Food Policy Research Institute, also show such potential.

12/ See the FAO Indicative World Plan, cited by Abercrombie (1975), and Ridken (1979).

13/ The population projections it uses are somewhat on the high side: 6.35 billion in 2000, 10 billion in 2030, and 30 billion in 2100 (Barney, 1980). The Global 2000 Report expects a disastrous lowering of per capita food consumption in sub-sahara Africa. It projects a total increase in the real cost of energy by 150 per cent by 2000.

14/ See Wijkman (1982) on the complex of issues in managing the commons. Abercrombie (1975) predicts serious social unrest if farmers do not share in the benefits of technical change in agriculture.

15/ For instance, India plans to have less than 30 doctors per 100,000 population by 2000; but by 1990 the United States will already have 220-250 per 100,000 (WHO, 1980). Bangkok has 230 doctors per 100,000 population, but Thailand as a whole has only 10 (Jones, 1975b).

16/ As a proportion of the GDP, public expenditures on EHH varies widely across countries (Tait and Heller, 1982). In general, it is very low among the low-income countries (1.0-1.3 per cent in India and Pakistan; however, 12.3 per cent in Botswana), clusters around 4-8 per cent in middle-income countries, and clusters around 9-13 per cent in the high-income countries; these are 1977 data. Also see Junes (1975c) for cross-country comparisons in the case of education.

17/ Because health and education are investments which also benefit the next generation to some extent, present distributional inequalities can lead to intergenerational inequalities as well (Sirageldin, 1975).



18/ Since estimated rates of return to schooling are typically highest at the elementary level and lowest at the tertiary level, Blaug (1979) favours holding back on public investment in higher education until access to lower levels has been completed; this was the path taken by Japan and the USSR in the past. This would be similar to the proposition that lands should not be allotted to the growing of feed grains until enough food grains have been produced.

19/ It is beyond the scope of this paper to dwell on certain means of improving efficiency in the EHH sectors, e.g., the tightening of the schooling employment relationship or the transfer and adaptation of health technology. While the pressure of population generates a corresponding pressure for greater efficiency, there would be cases where the demographic situation is neutral as to the preferred sources of better efficiency.

20/ According to Blaug (1979), the Achilles heel of all new ideas in education is that they always call for teachers who are enthusiastic, innovative and highly trained.

21/ For instance, the range among LDCs of the average teacher salary, relative to GDP per person of working age, is from 1.7 per cent in Sri Lanka to 5.4 per cent in Tanzania (Chau, 1972).

22/ In the Philippines, it is not uncommon for the annual volume of health personnel emigrants to equal the number of new health graduates, thus allowing no net addition to the local group. Would-be nurses from a relatively young population are receiving training oriented towards the health care problems of relatively old populations.

23/ Except that there was no apparent change in India (also see Patel, January 1980) and a possible increase in the sub-Sahara.

24/ The empirical measures of the Kuznets pattern are based on past data, incorporating the history of institutional change. However, the pace of forthcoming institutional change may well be much more rapid.

25/ The Global 2000 Report projects an average annual GNP growth rate of 4.5 per cent for the LDCs versus only 3.3 per cent for the most developed countries; but this implies that for every dollar increase in GNP per capita in the former there would be a \$ 20 increase in GNP per capita in the latter. Leontief (1977) estimates that the gap in per capita GNP could be cut from 12:1 in 1970 to 7:1 in 2000 if the GNP growth rate for LDCs were raised to 5 per cent per year and that for the most developed countries were lowered to only 3 per cent per year. He feels that these are technologically feasible rates but warns of social and political limitations.

26/ See the section by Schultz in Birdsall et al., 1979.

27/ For instance an article, "Year 2000: the shape of things to come", in U.S. News and World Report, (26 April 1982) speaks of robots, electronic homes and defense as the growth industries of the future.



28/ The 1978 World Development Report states (p. 66):

"Success is far more likely if governments set themselves explicit targets for the growth of incomes of the poorest groups and for the extension of basic public services, and then monitor progress regularly. The paucity of data on incomes, nutritional deficiencies, and access to public services reflects the absence until recently of policy concern with the poor and of anti-poverty programmes with specific objectives. The collection of data on the conditions of the poor is within the capacity of most countries....."

29/ See, for instance, the concern expressed by the United States Commission on World Hunger that the American people are only dimly aware of the hunger problem and maintain wasteful habits for lack of an appreciation of global resource limits. According to the United States Council on Environmental Quality, the United States is one of the largest sources of polluting by-products in the world.

30/ The present target annual funding level for international population programmes is \$ 1 billion; a future target appears to be \$ 3 billion. In comparison, the annual global level of military expenditures now comes to \$ 480 billion (Brown, 1981). The Middle East is particularly important to the food issue since, security problems aside, it is the most logical place for the establishment of fertilizer plants (Johnson, 1976).

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## B. Population and international economic relations

United Nations\*

### Introduction

One of the major concerns of international economic co-operation is to restructure the world economy in order to bring about a more balanced and equitable distribution of wealth and economic activities. Accelerating the development of developing countries would help in reducing disparities in income within and among nations and would contribute to the eradication of poverty.

Demographic factors as well as the international environment have an important impact on the development efforts of developing countries. The first part of this paper explores interrelationships between population, development and international economic relations. The trade requirements of a growing population under the International Development Strategy are then discussed. The chapter concludes with some reflections concerning the nature of the structural adjustments in the world economy necessary to create an international environment supportive of the development needs of the developing countries and conducive to a sustained growth of the world economy.

### The international setting

#### Distribution of world population, production and trade

Table 1 shows the distribution of world population, production and exports in 1960, 1970 and 1980. The developing countries and the socialist countries of Asia which have the highest concentration of population, representing almost 72 per cent of the world total, accounted for only 20 per cent of world production in 1980. While the relative weight in world output of developed market economies has declined in the last two decades, most of world productive activities are still concentrated there. In 1980 their share in world GDP was 65 per cent. This indicates a most uneven distribution of production considering that less than one fifth of the world population is in this group. The socialist countries of Europe, representing 9 per cent of world population, accounted for over 15 per cent of world output.

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\* United Nations Conference on Trade and Development.



Table 1. Shares in world population, production and exports a/  
(Percentages)

	Population	Gross domestic product	Value added in manufacturing	Exports
<u>Developing countries</u>				
1960	42.9	11.9	6.9	21.5
1970	45.6	12.6	7.6	17.9
1980	48.7	14.7	10.2	28.0
<u>Socialist countries of Asia</u>				
1960	23.6	4.0	b/	1.6
1970	23.6	4.5	b/	0.8
1980	23.1	5.3	b/	1.0
<u>Developed market-economy countries</u>				
1960	22.9	72.1	76.0	66.8
1970	21.2	69.4	71.1	71.3
1980	19.4	64.7	63.2	63.1
<u>Socialist countries of Eastern Europe</u>				
1960	10.6	12.0	17.1 b/	10.1
1970	9.7	13.5	21.3 b/	9.8
1980	8.8	15.3	26.6 b/	7.9

Sources: UNCTAD, Trade and Development Report, 1981, and Handbook of International Trade and Development Statistics, Supplement, 1981.

a/ For GDP and value added in manufacturing, shares are based on values at 1975 prices and exchange rates, whereas export shares are based on current values.

b/ Share of socialist countries of Asia included in share of socialist countries of Eastern Europe.



A similar distribution pattern exists in world manufacturing production and exports, in both of which the relative weight of the developed market economies was 63 per cent in 1980. The developing countries have made impressive progress in these two areas. Their relative share in world manufacturing output has risen from 7 per cent in 1960 to over 10 per cent in 1980. In world exports, their share increased from 22 per cent to 28 per cent over the same period. However, relative to the size of the population, the distribution of gains from these economic activities is highly unbalanced and has worsened in many cases.

### The income gap

In the last two decades the developing countries have grown more rapidly than the developed market economies (see table 2). In the 1960s, a period of relative stability and expansion in the world economy, the average annual rate of growth of GDP in the developing countries was 6 per cent as compared with 4.9 per cent for the developed market economies. However, because of a more rapid rate of population growth averaging 2.6 per cent per year, output growth in per capita terms in the developing countries was lower, or 3.3 per cent as against 3.8 per cent for the developed market economies. As a result, the relative income gap between the two groups widened during that period (see table 3). The economic crisis in the 1970s affected the pace of productive activities in all economic groups, the deceleration being more pronounced in the developed market economies. During this decade growth in GDP per capita in the developing countries exceeded that of developed market economies. While this resulted in the narrowing of the overall relative income gap, the gap in 1980 of 11.8 was still higher than that of 1960.<sup>1/</sup>

The wide disparities both in economic performance and levels of per capita income that exist among the developing countries are not reflected in the overall averages cited. The fast-growing exporters of manufactures and the major petroleum exporters have succeeded in narrowing the relative income gap with the developed market economies. Growth performance in these two groups exceeded even the targets set by the International Development Strategy for the First and Second United Nations Development Decades. However, they number only a few countries representing less than 28 per cent of the population of the developing countries. For the low-income petroleum-importing countries, where more than one half of the population of the developing countries live, production increases barely kept pace with population growth. The annual rate of increase of per capita income averaged only 1.1 per cent in the last two decades. Thus income distribution is very uneven among developing countries as well. While the relative income gap between the low-income and the higher-income developing countries is large, that between the low-income developing countries and the developed market economies is enormous.

The World Bank estimated that in 1980 about 750 million people in developing countries lived in absolute poverty, a living condition characterized by malnutrition, illiteracy and disease.<sup>2/</sup> A large portion of these people live in countries belonging to the low-income group. Higher income levels are essential to the reduction of poverty. As the ultimate aim



Table 2. Average annual rates of growth of production, population and per capita product a/  
(Percentage)

Economy group	Production		Population		Per capita product	
	1960- 1970	1970- 1980	1960- 1970	1970- 1980	1960- 1970	1970- 1980
Developed market economies	4.9	3.1	1.1	0.8	3.8	2.3
Socialist countries of Eastern Europe	6.7	4.9	1.1	0.9	5.6	4.0
Developing market economies	6.0	5.2	2.6	2.6	3.3	2.6
Petroleum-importing economies	5.3	5.2	2.5	2.6	2.7	2.6
Low-income petroleum- importing economies <u>b/</u>	3.8	3.4	2.4	2.5	1.3	0.9
Least developed economies	2.8	3.5	2.6	2.7	0.3	0.8

Source: "Overall socio-economic perspective of the world economy to the year 2000" (preliminary draft), Report of the Secretary-General (A/37/211 and Corr. 1-4).

a/ Gross domestic product in market economies and gross material product in socialist countries, measured in 1975 prices and exchange rates.

b/ Countries with per capita GDP of less the \$ US 300 in 1975.



Table 3. GDP per capita in the market economies, 1960, 1970 and 1980

Economy group	Level in 1975 US dollars			Relative income gap a/		
	1960	1970	1980	1960	1970	1980
Developed market economies	3435	5000	6300	1.0	1.0	1.0
Developing marked economies	298	412	535	11.5	12.1	11.8
Petroleum-importing economies	274	356	462	12.5	14.0	13.6
Low-income petroleum importing economies	126	142	155	27.3	35.2	40.6
Least developed economies	137	148	153	2.51	35.2	41.2

Source: "Overall socio-economic perspective of the world economy to the year 2000" (preliminary draft), Report of the Secretary-General (A/37/211 and Corr. 1-4).

a/ Ratio of GDP per capita of developed market economies to that of the specified economy group.



of development is to improve the chances of all people for a better life, it is necessary that growth in developing countries, particularly in the poorer countries, be accelerated.

### Population and development

#### Population and income levels

While there are still sparsely populated areas where rapid population growth might result in the more efficient use of natural resources, conditions in most developing countries are such that a slower rate of population growth could ease the problems associated with improving standards of living and reducing poverty. High population growth brings serious pressures on already inadequate social services and can increase the difficulties of generating an economic surplus usable for capital accumulation and economic infrastructure. In such circumstances it is even more difficult to determine the proper balance to be maintained between social and economic development programmes. In this context it is worth underlining that the merits of human development programmes extend beyond purely social considerations. They also enhance the productive capacities of the population which, if opportunities existed, could be transformed into economic gains.

Empirical evidence supports an inverse relation between the rate of growth of population and the income per capita level.<sup>3/</sup> While the precise mechanisms are not clear, it would appear that causation runs in both directions. GDP per capita might be an imperfect measure of welfare but it does provide an indication of what could be spent by each individual on basic necessities and human improvement. It also determines the potential tax base and hence the ability of the Government to finance education, health, nutrition and family planning programmes. Expenditures on human development can affect not only population growth through fertility reduction but can also promote long-term economic growth through their effect on productivity.

#### Population, labour force and urbanization

Population plays a vital role in development since it determines the supply of human productive resources. In addition, human skills and ideas are the source of technological and scientific inventions. However, as already pointed out, excessive population growth imposes constraints on economic resources. Moreover, where opportunities for the realization of human potentials are limited, social tensions might arise.

The world distribution and rates of growth of the economically active and urban population are presented in table 4. The labour force in developing countries, which accounted for 45 per cent of the world total in 1980, has been growing at an average annual rate of 2.1 per cent over the last two decades. The labour force is largely determined by demographic trends and an unprecedented expansion of over 2.4 per cent per annum is expected from now until the end of the century. Given the already high levels of unemployment existing in the developing countries, the task of providing enough productive



Table 4. World distribution and rates of growth of economically active and urban population (Percentage)

Economy group	World distribution			Annual average rates of growth	
	1960	1970	1980	1960-1970	1970-1980
<u>Economically active population</u>					
World	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>1.5</u>	<u>1.6</u>
Developed market economies	21.5	20.4	18.8	1.0	0.8
Developing market economies	41.0	42.7	45.0	2.0	2.2
Socialist countries of Eastern Europe	12.5	11.8	11.2	1.0	1.1
Socialist countries of Asia	25.0	25.1	25.0	1.5	1.6
<u>Urban population</u>					
World	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>3.0</u>	<u>2.8</u>
Developed market economies	41.5	37.4	33.0	1.9	1.6
Developing market economies	30.2	34.7	40.1	4.4	4.3
Socialist countries of Eastern Europe	14.9	14.2	13.3	2.5	2.2
Socialist countries of Asia	13.4	13.7	13.6	3.3	2.7

Source: Compendium of Social Statistics (United Nations publication, Sales No. E/F.80.XVI.2).



employment to absorb the growing labour force of these countries is formidable, indeed.

The urban population of developing countries, which has been growing at a very rapid rate of 4.4 per cent per year in the last two decades, is now greater than that of the developed market economies. In 1980 the developing countries accounted for 40 per cent of world urban population as against 33 per cent for the developed market economies. The speed of urbanization has not been accompanied by a parallel increase in employment. As a result, unemployment and underutilization of skills are prevalent and the absence of suitable employment opportunities has encouraged the emigration of highly skilled professionals.

In the coming decade the growth of the potential labour force in developing countries will be concentrated in the non-agricultural sector. The agricultural population is expected to grow at around 1.1 per cent as against 2.6 per cent for the total population. Since the agricultural population is some 57 per cent of the total, population growth in the non-agricultural sector could be as high as 4.6 per cent. With historical productivity increases, unemployment rates can be expected to grow rapidly unless there is a significant acceleration in the economic growth. It is important to note that the movement out of agriculture contains a relatively high proportion of people of working age and hence, the potential labour force in the non-agricultural sector would grow still faster than its population, perhaps at an annual rate of 4.8 per cent. Assuming that the long-term rate of growth of productivity in the non-agricultural sector of developing countries were to attain a level of 2 per cent, close to the historical rate of 1.9 per cent, gross value added in the sector would need to expand by 6.9 per cent a year merely to prevent any further increase in already high unemployment rates. Given the historical relationship between the agricultural and non-agricultural sectors, this would imply a growth in GDP of at least 6.3 per cent per year.<sup>4/</sup>

A substantial acceleration in development would therefore be needed in order that developing countries could absorb a greater proportion of the labour force. To a large extent, policy measures could ease the employment situation. A better balance could be sought between rural and urban development. Rural development, by generating employment activities, could counteract the exodus to urban centres. Moreover, increased agricultural production and income could raise demand for non-agricultural products and services and hence, create additional employment. In the long run, population policies, such as family planning programmes, could help in reducing the potential labour force and the growth of urban populations.

The declining trend in the labour force in developed market economies is expected to continue. At present, because of the prolonged recessionary conditions and the increasing participation of women in the work force, growth in the labour force is greater than that of employment. However, in the longer run a return to normal growth could lead to a serious labour shortage. These opposing trends in the projected labour forces of developed and developing market economies offer a mutually beneficial solution which could ease a potentially disturbing world labour situation. As a part of that



solution, a revamping of international industrial structures so that labour-intensive processes could be undertaken in developing countries may be warranted. A somewhat increased mobility of labour in certain cases could also be an element.

### International economic relations and development

The discussion in the preceding section dealt with the major role of population as a determinant of production. Because of the close link between production and international economic relations, any change in the rate of growth of population would have implications for trading patterns and the flow of capital. Population also directly affects the level of consumption and hence, import demand for consumer goods and for raw materials and the capital equipment necessary to produce goods for final consumption. There is evidence to support the view that the savings rate could be influenced by demographic trends. While there may be other more important factors that could account for the declining savings rate in developed market economies, the role of the changing age structure of the population should not be discounted. This poor savings performance has an impact on the availability of capital flows to developing countries. Other direct connections between population and international economic relations may be mentioned, such as the effect of the growth and changing skills of the labour force on the growth and composition of exports, but a more detailed analysis would require further research. This section therefore limits itself to a discussion of the linkage between development and international economic relations. Recent trends in these areas are presented in order to lay the groundwork for some of the issues set forth in the concluding section of the paper.

### International trade

International efforts to reduce trade restrictions after the Second World War resulted in a rapid expansion of trade which had highly positive effects on domestic production, industrialization and employment. The yearly growth of world exports was 8.2 per cent, with all major economic groups registering annual increases of over 8 per cent (see table 5).<sup>5/</sup> The general decline in world economic activity in the 1970s led to a deceleration in world export growth to 5.9 per cent per year. Excess capacity and unemployment in developed market economies brought about an emergence of protectionist measures. These measures discriminated against the exports of developing countries, in particular exports of agricultural products and manufactured goods. Despite this, however, the petroleum-importing countries managed to raise their export growth from 5.8 per cent in the 1950s to 6.7 per cent in the 1970s. The growth of import demand in the developing countries in the 1970s of 8.5 per cent per year was substantially higher than the world average. This factor has contributed in no small measure to reducing the severity of the recession in the developed market economies.

The strong association which generally holds between the rates of growth of exports, imports and output could be gleaned from a comparison of tables 2 and 5. The importance of the role played by international trade in



Table 5. Annual average rates of growth of exports and imports a/  
(Percentage)

Economy group	Exports		Imports	
	1960- 1970	1970- 1980	1960- 1970	1970- 1980
World <u>b/</u>	<u>8.2</u>	<u>5.9</u>	<u>8.2</u>	<u>6.0</u>
Developed market economies	8.3	6.4	8.7	5.3
Socialist countries of Eastern Europe	8.4	5.6	7.9	5.9
Developing market economies	8.0	4.4	6.1	8.5
Petroleum-exporting economies	10.1	2.3	6.9	12.8
Petroleum-importing economies	5.8	6.7	5.9	6.6
Low-income economies	3.1	3.8	2.8	4.7
Least developed economies	4.6	4.6	5.6	4.9

Source: "Overall socio-economic perspective of the world economy to the year 2000" (preliminary draft), Report of the Secretary-General (A/37/211 and Corr. 1-4).

a/ Based on exports and imports of goods and non-factor services, measured in 1975 prices and exchange rates.

b/ Excluding socialist countries of Asia. The discrepancy between world export and import growth is due primarily to problems of reporting of trade statistics.



development varies from country to country depending on the openness of the economy. For the fastest growing developing countries, trade has provided the stimulus to growth, particularly in the manufacturing sector. For most of the developing countries, export earnings are the main source of financing imports of the raw materials and capital goods essential to their development.

Primary products still account for a large portion of total exports of developing countries, representing 81 per cent in 1980. However, this is largely due to sharp rises in oil prices which have brought the weight of fuel exports to 62 per cent. On the other hand, while the share of non-oil primary exports of oil-importing countries has declined significantly from the 1965 level of 71 per cent, it still accounted for almost 39 per cent in 1980. Furthermore, most developing countries are still largely dependent on exports of primary commodities. Heavy reliance on these products subjects these countries to current-account difficulties brought on by sharp and unpredictable fluctuations in commodity prices. Such difficulties are not conducive to smooth planning and development. Further, a number of countries still rely on one or a very few primary products for their export earnings, although the need for product diversification is generally recognized.

The exports of manufacturers of developing countries, while still representing only a minor portion of world exports of manufactures or 9 per cent in 1980, have been growing steadily. In the oil-importing developing countries, the relative weight of manufactures in their total exports nearly doubled from 21 per cent in 1965 to over 39 per cent in 1980.

The expansion in manufactures exports, a sign of rapid industrialization, was due largely to the fast-growing exporters of manufactures. Although labour-intensive products in which they have comparative advantage, such as clothing, footwear and electronics, constitute the bulk of their exports of manufactures, they have started to penetrate the markets of more advanced capital-intensive industries such as shipbuilding, machinery and basic chemicals.

As far as the commodity composition of imports is concerned, manufactures accounted for over 64 per cent of total imports of the developing countries in 1980, a share which has declined slightly from 68 per cent in 1965. A measure of the degree of external dependence on the supply of capital goods and the technology embodied in these goods is the weight of imports of machinery and transport equipment in total imports, which was 32 per cent in 1980.

The developing countries still depend heavily on trade with developed market economies. In 1980 the developed market economies provided the major markets of developing countries' exports absorbing 70 per cent of the total, a share which has been fairly stable since 1965. Industrialized countries are also the major source of their imports and while the share has declined noticeably from the 1965 figure of 71 per cent, it still represented 63 per cent of total imports in 1980.

One of the positive developments which arose out of the unfavourable international climate in the 1970s was the significant increase in trade among developing countries. The recession in industrialized countries which was



followed by a very slow recovery weakened the import demand of this group. At the same time, some developing countries were able to maintain their growth momentum and achieve relatively high rates of economic growth, thus providing good markets for each other. Moreover, major-oil exporting countries with their accumulated financial surplus provided a rapidly growing market. These developments accompanied by a more determined effort on the part of developing countries to diversify markets explain the buoyancy of trade among developing countries. In exports, intra-trade accounted for over 25 per cent of total exports in 1980, representing an appreciable increase over the 1970 figure of 20 per cent. The rise of the intra-trade component of total imports was more pronounced, rising from 19 per cent in 1970 to over 30 per cent in 1980.

The experience of the fastest-growing developing countries reflects the strong links between development, industrialization and international trade. Their liberal trading policies and outward orientation have contributed significantly to their success. International trade could promote a more efficient use of world economic resources leading to increased productivity and growth. However, shifts in the international division of labour in line with evolving comparative advantage could take place only in a stable and liberal international trade environment. Recent experience has cast some doubt on whether other developing countries will be able to follow the same strategy.

#### Capital flows

While external factors, particularly in the 1960s, have stimulated growth in developing countries, it must be stressed that their performance was mainly due to their own efforts. The ratio of gross domestic capital formation to GDP provides a good indicator of development efforts. This ratio has risen steadily from an average of 10-12 per cent in the 1950s to 18 per cent in the 1960s and almost 24 per cent in the 1970s. Developing countries have also succeeded in mobilizing a fairly large amount of domestic resources to finance their investment. The ratio of gross domestic savings to GDP increased from 25 per cent in the 1960s to 27 per cent in the 1970s. While these averages are largely influenced by the high savings rate in the petroleum-exporting countries, it is nevertheless indicative of the pace of savings efforts in the other developing countries. For the oil-importing countries, the average gross domestic savings rate increased from less than 17 per cent in the 1960s to over 20 per cent in the 1970s. While domestic savings financed over 85 per cent of the investment requirements of this group in the 1970s, it had to be supplemented by capital inflows. The least developed countries, which have a limited capacity to mobilize domestic savings, have had to rely increasingly on foreign savings which financed 39 per cent of investment needs in the 1950s and almost 52 per cent in the 1970s.<sup>6/</sup>

There has been a striking change in the composition of net long-term financial flows of oil-importing developing countries in the last decade. The share of official development assistance (ODA) has steadily declined from 44 per cent in 1970 to less than 37 per cent in 1980. The performance of the member countries of the Development Assistance Committee (DAC), with a few



notable exceptions, has been disappointing. The share of ODA from DAC member countries declined markedly from 40 per cent of net long-term flows in 1970 to 28 per cent in 1980. ODA as a percentage of GNP of DAC member countries averaged less than half of the 0.7 per cent target set by the International Development Strategy for the Second United Nations Development Decade. The doubling of the share of ODA from Oil-Producing and Exporting Countries (OPEC) within the decade to over 8 per cent of net long-term flows in 1980 cushioned the impact of the decline in the share of DAC member countries. The ratio of ODA to the GNP of OPEC member countries ranged from 1.4 to 2.6 during the period 1973-1980. The importance of ODA to the least developed countries cannot be overemphasized. In 1980 ODA constituted over 80 per cent of the long-term financing of these countries. Because of higher import costs, a substantial increase in such assistance is needed if only to maintain their present low standard of performance. Capital transfers on concessional terms, and in particular grants, are perhaps the most direct means of effecting international redistribution of income. It would, of course, be unrealistic to expect much from aid in narrowing the income gap between the industrialized and developing countries, but it could be critical in broad programmes for human development.

There has been a tremendous expansion of private bank lending as reflected in the doubling of its share in long-term financial flows from 19 per cent in 1970 to 39 per cent in 1980. However, access to capital markets is limited to the more advanced developing countries.

The weight of overseas direct investment, a significant portion of which is reinvested earnings, has declined considerably in the last decade, from 21 per cent in 1970 to 10 per cent in 1980. While only a small portion of net flows, it has contributed in promoting industrialization and increasing productivity of the fast-growing exporters of manufactures, particularly in Southeastern Asia.

Transnational corporations (TNCs) could play a beneficial role in the development efforts of developing countries. In addition to supplying capital, they could also provide technological and managerial know-how and create employment opportunities. While they were originally engaged mainly in the exploitation of natural resources, their activities have increasingly been directed towards manufacturing and services attracted by cheap labour and growing markets. Subcontracting labour-intensive processes to nationally owned enterprises in developing countries has been increasing in recent years.

However, the dominant power which TNCs have is a source of concern for developing countries insofar as this power imposes constraints on market forces, often preventing the entry of competitors. The TNCs' involvement in trade is considerable, particularly in markets of interest to developing countries. Moreover, they dominate the international marketing and distribution of primary commodities.

It is important that developing host countries adopt policies concerning their relations with transnational corporations, particularly in the employment of local workers and materials, in the use of appropriate technology and in the possibility of joint ventures. They should ensure that



activities of TNCs shall be integrated with the social and economic development efforts of the countries.

A positive development in the last decade has been the large inflow of earnings of residents of developing countries working abroad. Because of the labour shortage in the oil-surplus countries, they have encouraged immigration of temporary workers from other developing countries. As a result, workers' remittances have contributed significantly to reducing the balance-of-payments deficits of a number of Asian countries belonging to the low- and middle-income groups.

Trade requirements of a growing population under the  
international development strategy scenario 7/

Growth of GDP and population to the year 2000

The International Development Strategy postulated changes in resource-use patterns, structural transformations and international trade relations that would progressively lead to the attainment of accelerated growth in all groups of developing countries within the context of a New International Economic Order and in a manner consistent with the Lima Plan of Action.

While the growth targets set by the International Development Strategy were significantly higher than those achieved recently or those implied by longer-term trends, these rates are neither without historical precedent nor without contemporary example. For the rest of the century, the International Development Strategy postulated an average annual growth of GDP for all developing countries of 7 per cent, with growth in slow-growing countries accelerating faster (see table 6). With the exception of the low-income group, the projected acceleration was in accordance with standards of productivity growth already attained by the faster-growing economies of the group. For the low-income countries, it was assumed that GDP growth would accelerate steadily to double their per capita incomes by the year 2000. This would imply a rise in their labour productivity far above the historical performance of this group and would require altering present patterns of resource use and improving investment productivity. In the next two decades, developed market economies were projected to grow at the yearly rate of 4 per cent and developed planned economies at 5.2 per cent. Unfortunately, however, it is clear on the basis of the performance of the developed economies over the first three years of the decade that a reassessment of the assumptions underlying the International Development Strategy is in order.

Nevertheless, while the rate of population growth for developing countries as a whole had already reached its peak in the early 1970s, population pressures will remain severe, particularly through this decade. For the least developed countries, the pace of population growth is expected to accelerate over the 1980s. Only towards the end of the century will declines in population growth be apparent in all groups of developing countries. In developed countries the decline in population growth is expected to continue.8/



Table 6. Annual average rates of growth of population and selected economic variables of developing countries, historical for 1970-1980 and projected under the International Development Strategy for 1980-1990 and 1990-2000 (Percentage)

Economy group	GDP	Population	GDP per capital	GDP per active person	Exports	Imports
Developing market economies						
1970-1980	5.2	2.6	2.6	3.0	4.4	8.5
1980-1990	7.0	2.6	4.3	4.5	6.7	8.0
1990-2000	7.0	2.3	4.7	4.4	8.0	7.9
Petroleum-importing economies						
1970-1980	5.2	2.6	2.6	3.0	6.7	6.6
1980-1990	7.0	2.5	4.4	4.6	7.8	8.3
1990-2000	7.0	2.2	4.7	4.4	8.7	8.0
Low-income economies						
1970-1980	3.4	2.5	0.9	1.4	3.8	4.7
1980-1990	7.0	2.5	4.4	4.6	7.5	8.2
1990-2000	7.1	2.2	4.8	4.6	7.9	8.2
Least developed economies						
1970-1980	3.5	2.7	0.8	1.2	4.6	4.9
1980-1990	6.4	2.9	3.3	3.7	7.7	8.7
1990-2000	7.2	2.7	4.4	4.4	8.3	8.8

Source: "Overall socio-economic perspective of the world economy to the year 2000" (preliminary draft), Report of the Secretary-General (A/37/211 and Corr. 1-4).



Given the projected population growth for developing countries of 2.6 per cent in the 1980s and 2.3 per cent in the 1990s, the GDP per capita growth target would be 4.4 per cent in the 1980s and 4.7 per cent in the 1990s. It is worth noting that the achievement of the ambitious growth targets set by the International Development Strategy would only make a modest beginning towards narrowing the relative income gap between the developed and developing countries by the end of the century (see table 7). For the low-income countries, the gap in 2000 would still be greater than that in 1960. This limited progress, however, is very important in that it could provide the momentum for a sustained drive towards the elimination of the worst aspects of poverty in all areas of the world.

### Investment and savings

Accelerating the growth of developing countries would require a faster accumulation of capital or an increase in the investment to GDP ratio from 26.7 per cent in 1980 to 28.8 per cent in 1990 and 27.6 per cent in 2000. Because of the generally rising historical trend of this ratio, the target rate of capital formation would seem to be within the reach of all groups of developing countries, except the low-income groups. For the latter group, the investment ratio was set to rise to an average of almost 28 per cent in the next two decades from a level of 20 per cent in 1980.

While greater investment efforts would be required, higher standards of capital productivity would be equally important. The incremental capital output ratio (ICOR), which provides a measure of investment efficiency, has demonstrated a notable tendency to rise over time in all groups of developing countries. Moreover, the ICORs in low-income economies are generally greater than in the higher-income countries. This is due to the fact that infrastructure investment with long gestation periods is a large component of total investment in these countries. For developing countries as a whole, the International Development Strategy postulates an ICOR of 4 for the rest of the century which represents a standard of investment efficiency already achieved in the past.

In the petroleum-exporting countries, a continued upward movement in private consumption shares was projected. For the other groups, the long-run decline in this ratio, which might have been influenced by policies to encourage savings, was assumed to continue. Special measures which would ensure that there should be no reduction in consumption levels of the poorest portion of the population would possibly have to be introduced. The share of government consumption to GDP was projected to rise, continuing the increase in the late 1970s. While the resulting savings show a substantial rise, particularly in the low-income countries, they would still be inadequate to finance the investment requirements of the International Development Strategy. As a consequence, external resources would need to fill the gap.



Table 7. Relative income gap and percentage shares of selected economic variables in GDP of developing countries, historical for 1980 and projected under the International Development Strategy for 1990-2000

Economy group	Relative income gap <u>a/</u>	Percentage of GDP at 1975 prices and exchange rates			
		Investment	National savings	Internal balance <u>b/</u>	External balance <u>c/</u>
Developing market economies					
1980	11.8	26.7	25.0	-1.8	25.0
1990	10.6	28.8	26.1	-2.7	27.4
2000	9.5	27.6	26.9	-0.7	29.7
Petroleum-importing economies					
1980	13.6	25.3	20.8	-4.5	21.8
1990	12.2	28.0	23.8	-4.2	24.8
2000	10.9	27.2	25.5	-1.7	27.2
Low-income economies					
1980	40.6	20.0	15.7 <u>d/</u>	-4.3	14.7
1990	36.9	29.2	21.1	-8.1	16.5
2000	32.5	27.7	24.5	-3.2	18.4
Least developed economies					
1980	41.2	10.8	8.2 <u>d/</u>	-8.6	21.3
1990	41.1	26.9	10.8	-16.1	26.4
2000	37.5	26.8	16.7	-10.1	30.9
					-8.6
					-13.2
					-17.2

Source: "Overall socio-economic perspective of the world economy to the year 2000" (preliminary draft), Report of the Secretary-General (A/37/211 and Corr. 1-4).

a/ Ratio of GDP per capita in developed market economies to that of the specified economy group.

b/ National savings less gross domestic investment.

c/ Exports less imports plus net factor income from abroad.

d/ Obtained as a residual.



### Trade requirements and the resource gap

The resulting external balance in the year 2000, as shown in table 7, would be 4.8 per cent of the GDP of developing countries as a whole. It should be noted that because of the considerable uncertainty of predicting relative price movements, the terms of trade were assumed to be constant throughout the projection period. Thus any change in the terms of trade would affect the actual external balance. The projection allowed a divergence between the savings-investment gap and the export-import gap. The reconciliation of the two gaps would involve decisions regarding stimulating savings, should the internal gap be dominant, or reducing imports and/or increasing exports should the external gap dominate. For the oil-importing countries as a whole, the external gap is expected to dominate in the next two decades, although for those in the low-income group the savings constraint would be dominant in the 1980s. The gaps projected are large and especially so for the least developed countries in which the dominant gap is 16 per cent of the target for GDP in the 1980s and over 17 per cent in the 1990s. Such gaps would require tremendous domestic efforts to fill, but even this would not be sufficient and would therefore need to be supplemented by resource transfers.

Accelerated growth in the world economy and in the developing countries in particular would magnify the structural shifts in the pattern of world production and resource allocation now taking place in the world. Associated with such shifts would be changes in the pattern and volume of world trade. In developing countries, the structural transformation would involve a progressive increase in the share of industry in economic activity as not only labour-intensive but more and more capital- and skill-intensive lines of production are established. By the year 2000 value added in industry would account for almost 52 per cent of their GDP on the basis of the International Development Strategy. In manufacturing, their share of world manufacturing output would be 20 per cent or almost double that of 1980. These structural changes would result in a corresponding shift in export pattern from primary products to manufactured goods. For the developed market economies, the transformation would take place in the composition of their industry, involving shifts to skill, research and capital-intensive processes and away from labour-intensive activities. A new international division of labour based on greater diversification of world material production would evolve, producing the foundation for a return to a rapid expansion of world trade.

### Some reflections in the light of the current situation

As has been outlined in the above discussion of interrelationships among population, production and trade, there are fundamental reasons for according a central place to demographic patterns in the analysis of world development needs. Unfortunately, it is clear that current economic trends are worsening the long-term situation rather than alleviating it. The world economy is currently suffering from the worst recession of the post-war period. Indeed, unemployment in the developed market economies is currently at levels comparable to those of the Great Depression. Furthermore, the growth of developing countries as a whole has dropped to the lowest rates ever



recorded. Per capita incomes are declining for the bulk of the population in developing countries. While the financial burdens being carried by developing countries are severe and are worsening, developing countries have been attempting to cope by improving domestic performance including, in particular, savings performance. On the other hand, the developed market economies' performance has been characterized by falling savings and investment rates.

Further, the current situation is complicated by certain demographic factors that are of long-term significance. To state the obvious, rates of growth of population are very different in different regions of the world and in particular as between developed and developing countries. Second, the rate of growth of the labour force in the developed market economies is slowing and may even become negative in the last half of this decade. On the other hand, the rate of growth of the labour force in the developing countries will continue to be high for some time to come. Among other factors explaining this phenomenon, it might be noted that the population in the developed economies is aging significantly; the labour force participation rate of women is quite high in these countries as compared with developing economies, and, finally, the rural-urban migration now characterizing the developing economies is likely continue for some time to come.

These demographic factors have very direct economic implications. The fact that population growth rates in the two regions are quite different implies that in order to reduce or even stabilize the income gap, the rate of growth of gross domestic product must be substantially greater in developing economies than in developed. Second, the fact that the urban population of developing countries is growing so rapidly implies that industrialization must be carried out at a rapid pace in order to absorb the urban labour force. Further, the rate of growth of productivity in agriculture must be maintained at a high level and massive investments in infrastructure are required.

Thus it is clear that the investment needs of developing countries are substantial. At the same time the short-term rate of return on overall investment will be relatively low because of the long gestation periods involved in infrastructure investment. Therefore, not only do high investment requirements imply that significant transfers of capital from developed to developing economies will be needed for a considerable period of time, but that the terms and conditions of the associated finance will need to reflect the heavy infrastructure component. At the same time developing economies will need to rapidly expand their exports to developed market economies in order to complement the capital inflows with increased mobilization of domestic resources.

In turn, these requirements indicate that the developed market economies will need to improve substantially their savings performance in order to make available financial resources needed by developing economies. At the same time they will have to allow a fairly rapid penetration of their markets by developing countries. However, given that the population in the developed economies is aging significantly it is probable that there will be some difficulties involved in improving their saving performance. Furthermore, it will likely prove difficult for developed economies to significantly open their markets to exports from developing countries as long as their economies are stagnating.



In summary, it would appear that there are very real difficulties involved in restructuring the world economic system to serve world development needs as reflected in long-term population patterns and trends. In particular, the economic policies adopted at the national and international level to deal with current problems must take into account the longer-term difficulties that are likely to emerge.

#### Notes

1/ Better estimates by the International Comparison Project of per capita income differences based on direct price comparisons of very specific goods and services indicate a smaller gap than that shown in table 3, although they still imply a very large gap between the two groups.

2/ World Bank, World Development Report, 1980 and 1981. This amounts to approximately 17 per cent of the world's population.

3/ The inverse relationship only becomes apparent above a certain minimum per capita income level. Of course, it is only one element in a very complex and varied picture.

4/ United Nations Conference on Trade and Development, Trade and Development Report, 1981.

5/ For developing countries, the strong export performance was due primarily to a rapid rise in petroleum exports.

6/ The use of investment ratios which are lagged by one year may produce inconsistencies but would not significantly alter the actual figures.

7/ This section is based mainly on "Overall socio-economic perspective of the world economy to the year 2000" (preliminary draft). Report of the Secretary-General (A/37/211 and Corr. 1-4).

8/ The population figures correspond to the normal variant of the projections of the Population Division of the United Nations. The consumption and import functions of the econometric models used in projecting the main economic variables under the International Development Strategy are on a per capita basis. Therefore population directly affects the levels of consumption and imports.



## C. Development, life-styles, population and environment in Latin America

United Nations\*

### Introduction

The population-environment-resources debate, in the United Nations and outside, is more than a decade old. It has been noted for its polemic overtones, especially in the days preceding the Stockholm Conference. The issues were kept on the agenda of the United Nations, most prominently by mounting a system-wide co-ordinated research programme on population, resources, environment and development interrelationships.

The introduction to this chapter will dwell briefly on some of the related problems, from the vantage point of the practical experience and learning of the Economic Commission for Latin America (ECLA) and its policy perceptions as a United Nations regional commission located in the third world. This point ought to be noted, because the major thrust of the population, resources, environment and development exercise appears directed at the developing countries.

The neo-Malthusian overtones of some statements on environmental problems helped, in the 1960s, to bring to the attention of the public and decision-makers many of the issues hitherto ignored. They also did a lot of damage to the environmental cause, because of their one-sidedness and politically naive postulations. The developing countries, in particular, reacted negatively to the discussions of the threats to natural resource availability and to some of the prescriptions that were proposed on how to deal with them. They showed special sensitivity to anything having to do with population growth. It should not be surprising, therefore, that the Stockholm Conference Declaration and the Action Plan virtually ignored the population issue.

The Bucharest World Population Conference was more explicit on the population resources environment interrelationship, presenting the issue in a manner agreeable to the participating countries. In the wake of the sixth special session of the General Assembly and the adoption of the new international economic order in General Assembly resolutions 3201(S-VI) and 3202 (S-VI) of 1 May 1974, the Cocoyoc Declaration represented a further attempt to bring a greater policy and substantive balance into the ongoing discussions. Cocoyoc, among other things, highlighted the impacts of the patterns of development and life-styles in industrialized countries on the global environment and the natural resource base. The General Assembly call for mounting the population, resources, environment and development programme was partly inspired by the Cocoyoc Declaration, which was circulated as a document of the Second Committee.

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\* Economic Commission for Latin America and the Caribbean.



While slow in starting, in the last few years the programme has resulted in notable advances in understanding and analysing the issues involved, and in exploring lines of action that could be fruitfully pursued at the international level. Still, some of the old controversies persist. It is also difficult to apply a truly integrated perspective to the issues at stake. And, occasionally, some overly simple notions, including those borrowed from the biological sciences, get pulled into the discussion in order to handle a very complex social reality.

Although development subsumes population, resources and environment, there are other variables in the development process, which are as important and cannot be left out. Thus, it can be argued that the "integrated" or "systems" approach to development would be a more adequate concept to use, and by definition would subsume the interrelationships of population, resources, environment and development. In practice, however, the formula for the programme is an attempt to highlight the complex interaction between these variables - an interaction that paid lip service to or is not effectively dealt with in the decision-making process. Thus, there is a value in giving them policy relevance and visibility in various programmes and documentation.

There are several policy premises that have emerged through the studies and debates over the past decade. These can be summarized briefly as follows:

(a) This is not a demographic exercise. It is primarily addressed to the interrelationship between society, on the one hand, and the environment and the natural resource base, on the other hand, as realized through the development process. In this, population is a dependent variable. Thus, in some instances, population and demographic factors play a marginal role in the way the interrelationship evolves; in other instances, they are of critical importance. This was recognized by the General Assembly when it substituted the term "people" for "population" in the title of the interrelationship exercise. It could have as well gone one logical step further, by substituting "society" for "people". "People" interact with the environment and natural resource base through their society, and as members of society. They are not an amorphous mass or numbers. Nor are they free or freely inspired agents.

True, however, by substituting "society" for "population", one would have reduced the prominence of the demographic variables, and thus have denied the programme an important foothold in the work of the United Nations.

(b) There is a great diversity of ways and of relative importance in which population, resources, environment and development issues are manifested in practice. This is affected by such factors as levels of development, geographical and climatic characteristics, the natural resource base, socio-economic structures and patterns, poverty and wealth, technological development, tradition and culture, the nature of ecosystems, growing integration and the interconnectedness of the international community and global processes.

(c) Development styles, or put differently, patterns of development and life styles, and societal arrangements, play a critical role in the



interrelationship, and make for a fundamental difference in the nature and scope of the impacts on the environment and the natural resource base of a given population number.

(d) Environmental pollution and the use of global resources depend more on the consumption patterns and life styles of the developed countries and of their diffusion to developing countries, than on the rates of population growth of the latter.

Accepting these premises and relying on empirical work done by ECLA it will be illustrated how the demographic dynamics of Latin America in the last two decades and the environmental problems being faced by the people of the region are related to the specific productive structures and consumption patterns which, to different degrees depending on the country, prevailed during that time and are now even more widespread in Latin America.

That task faces three major problems. One of them stems from the diversity of situations found in the Latin American region. That diversity refers to levels of development, to the rates of population growth and other demographic characteristics derived therefrom, to the way the population is distributed between and among internal regions and urban and rural areas, to different endowments of natural resources, to the type and depth of the environmental problems being faced, etc. These differences should be taken into account if a policy-relevant picture is intended, but to describe each and every situation is a task far beyond the scope of this paper. A compromise solution will be to approach the problem at two levels. The first one will be a description of what ECLA has identified as the common features of a development style which in different degrees has been or is being adopted by most Latin American countries, and to relate them to the major trends in social and demographic change. This will be unavoidably a rather abstract analysis. The second part of the paper will be a more concrete reference to two particular processes in which development, population, environment and resources are interrelated and to which ECLA has paid special attention: the survival of peasants in semi-arid ecosystems in highlands and the expansion of the agricultural frontier.1/

A second problem faced at both levels of analysis is that while the findings from environmental and socio-demographic studies reinforce each other, few if any environmental studies have up to now explicitly integrated the socio-demographic dimension, and vice versa, the environmental constraints are seldom taken into account in socio-demographic studies. This has left a number of gaps in our knowledge of the links between development, environment and population which have necessarily given this paper an exploratory character. In fact, the analysis of those links is a whole new area of studies which has still to be developed in Latin America and which ECLA plans to look into in more detail in the period to come.



Style of development, life-styles and  
population in Latin America

The import substitution stage characterizing the most economically advanced countries of the region during the 1940s and the 1950s, and gradually extended to some relatively less advanced Latin American countries, has slowly at first but rather abruptly in the 1970s evolved towards a new style of development characterized by a profound change in the form of insertion of Latin America in the world economy and in its process of internationalization and in the form of linking up with the industrialized countries, mainly of market economies. Transnational corporations play a dominant role in this process, as do private international banks. Moreover, the governments have followed policies of greater openness to the exterior in various economic, financial and technological fields.

The number of ECLA studies on this new style of development makes it unnecessary to attempt here a detailed analysis of its structure and functioning.<sup>2/</sup> The discussion that follows summarizes the main changes that style has introduced in the productive structure and in the life-styles and consumption patterns of the population, with a brief mention of some of the evidence showing the inequities in the distribution of the benefits of progress which have up to now been a central part of it.

Changes in the productive structure

Until the 1950s foreign capital was to be found in the sectors exporting primary products, and frequently in urban and transport services. Since then there has been a considerable rise in direct foreign investment in the manufacturing sector. Transnational corporations have now an important share in manufacturing output. They dominate the key sectors of greatest dynamism and technological progress, particularly in the chemicals, basic metals, engineering and automobile industries. They are the channel for a significant proportion of imports, of external financing and of the incorporation of technology by the countries of the region. They also play an important role in agro-industrial development. In contrast to what happened during the 1950s and early 1960s, when the bulk of capital flowing into Latin America was official long-term capital, a large proportion of it now comes from private banks and commercial sources, for the short or medium term. The public enterprise, especially in the large and medium-sized countries, still covers basic industrial areas with the aim of supporting overall and manufacturing development, and national private enterprise maintains its predominance in the traditional industries producing non-durable consumer goods, but transnational corporations are undoubtedly the main agents of production and of financing in the new style now dominating Latin American development.

Latin American manufacturing industry as a whole has developed significantly since the 1950s. The annual growth rate between 1950 and 1978 was 6.5 per cent which was above the world average of 5.9 per cent. That growth has been accompanied by major structural changes. In 1950 non-durable consumer goods represented almost two thirds of total manufacturing production, as opposed to roughly 40 per cent in 1978. In contrast, the



relative importance of intermediate products in manufacturing output has risen from less than 25 per cent of the total to more than one third in 1978. However, reflecting the changes that have taken place in life-styles, it is in the consumer durables and investment goods sector where the relative change has been most striking. This sector represented 11 per cent of total manufactures in 1950 and in 1978 it accounted for more than one quarter of manufactures produced. While manufactures of non-durable consumer goods declined in relative importance, their growth rate was well above that of the population, and thus the per capita supply of such goods increased throughout the period.

The transformation of the Latin American productive structure that has taken place between 1950 and today could not but modify the composition of the labour force. Broadly defined, the industrial sphere (including manufacturing, construction, electricity and transport) employed about 22 per cent of the economically active population in 1950 and 27 per cent in 1980. This involved annual growth rates of 2.7 per cent between 1950 and 1970 and 3.8 per cent between 1970 and 1980. Adding to this the indirect effects of other activities, industrialization affected 35 per cent of the labour force in 1950 and 47 per cent in 1980. The share of the tertiary sectors (commerce and services) also increased during the period from 23 per cent in 1950 to 36.9 per cent in 1980 but, on the contrary, the agricultural labour force decreased from 53.8 per cent in 1950 to 35 per cent in 1980.<sup>3/</sup>

Together with changes in the economic structure and the composition of the labour force, the expansion of the educational system and high urbanization rates have contributed to a rapid increase of the middle sectors. With respect to education, enrolment increased considerably at all levels between 1960 and 1980, but that of young people between the ages of 18 and 23 studying in institutions of higher education was particularly explosive, rising from slightly over 6 per cent to 16 per cent.<sup>4/</sup> With regard to urbanization, the population living in locations of 20,000 inhabitants and over rose from slightly more than 40 million in 1950 to nearly 173 million in 1980, absorbing 66 per cent of the total population growth in the region during the period. The resulting considerable expansion of the middle sectors in the last decades has led one of the authors of the most recent study on the subject to conclude that "in the 1980s some countries are attaining and even exceeding the proportion of middle class existing in the developed countries, while others are rapidly approaching such levels".<sup>5/</sup>

Changes in the economic and industrial structures and increasing urbanization have also contributed to an increase in the number of urban-industrial wage workers, particularly in the medium and large-sized countries, although there are signs that the trend might have slowed down or even stopped in some of them during the late 1970s.

The emerging style of development has also extended to the agricultural sector. The Latin American agricultural process in the last quarter of a century has led to a transformation of the traditional hacienda system to make way for an agrarian structure which - maintaining a high concentration in the ownership of natural resources - is better adapted to the requirements of the now dominant style. The landownership agriculture-peasant agriculture



dichotomy has increasingly become the capitalist agriculture-peasant agriculture relationship. The rapid growth of the number of capital/technology-intensive farms has introduced significant changes in agriculture. More use of fertilizers, improved seeds and machinery are clear manifestations of these changes. Between 1951 and 1975 the average annual rate of increase of the use of fertilizers was a little over 13 per cent and their use per hectare harvested rose from 5.5 to nearly 45 kilogrammes. Similarly, the number of tractors increased 5.5 fold between 1950 and 1975.<sup>6/</sup> There are, however, wide differences between countries, types of establishments, production items, and specific geographical areas.

The growth of capitalistic agriculture is closely associated with the transnationalization of agricultural activities and the organization of transnationally controlled agro-industrial complexes. Concentrated in Latin America are nearly 30 per cent of the total number of investments made by transnational food and beverages firms abroad, 70 per cent of which are of North American origin.<sup>7/</sup>

The development of capital and technology-intensive agriculture has not necessarily meant a reduction of peasant economy or an increase in the proportion of the agricultural labour force who are wage earners. On the contrary, although there are wide inter-country variations,<sup>8/</sup> the persistence of peasant agriculture is another major characteristic of recent Latin American agricultural development. On the other hand, the growing substitution of seasonal for permanent workers has conspired against the expansion of the latter and in part explains the survival of a peasant economy.

Although a detailed analysis of the style of the development-resources relationships falls beyond the purpose of this paper, it cannot but be mentioned that the dynamism and the productive and technological changes characterizing the dominant development style have led to striking differences between the structure of energy supply and demand. Latin America has abundant resources of the three traditionally most important forms of commercial energy: hydrocarbons (petroleum and natural gas), hydroelectricity and coal, but they are distributed very unevenly in the region. The sources of hydroelectricity are considerable and more uniformly distributed. This is not true of hydrocarbons or coal, the known reserves of which are concentrated in a few countries (oil in Venezuela and Mexico; coal in Colombia and Mexico). In contrast, the structure of demand for energy in all the countries is fundamentally based on petroleum. Although only five countries produce sufficient oil to meet their needs, the total consumption of hydrocarbons represents 75 per cent of total energy consumption. Hydroelectricity, on the other hand, is only used to a limited extent in relation to its production potential, and the importance of coal as a source of energy is even smaller. This trend has led to a relative decline in Latin America's exportable surplus: in 1950 the region consumed as products 27 per cent of its petroleum output and 17 per cent of its natural gas production; in 1979 these percentages had risen to 66 per cent and 52 per cent, respectively.<sup>9/</sup> Between 1960 and 1979 the consumption as products of Latin America's petroleum output increased from 300 kilogrammes per capita to 508 kilogrammes per capita, or almost 70 per cent; the consumption of natural gas increased five times during the same period. This increase in consumption has taken place despite the



stagnation and slight decline experienced by petroleum output during the 1970s, due to the conservationist policy applied by Venezuela which only after 1977 started to be compensated by Mexico's and Ecuador's increasing production. The higher demand for petroleum of the non-producing countries of the region had to be met with more imports. In relative terms oil imports increased 74 per cent between 1970 and 1979; however, the participation of the Latin American exporting countries in total regional imports decreased from 38 per cent in 1970 to 15 per cent in 1979. In other words, an increasing proportion of the petroleum imported by Latin American countries comes from outside the region, while at the same time the exports of petroleum from the region to Europe and the United States have increased.<sup>10/</sup> In this way the non-producing countries are now more vulnerable to decisions taken elsewhere and the oil-producing countries have strengthened their ties with the more developed world.

### Inequities in the distribution of benefits

The structural trends described above clearly indicate that Latin America has undergone a process of economic growth and social change of considerable importance since the 1950s. The nature of that process has led and still leads to the formation of highly inequitable societies, as borne out by the persistence of a very high concentration of income and wealth in small segments of the population, by the very large population strata living in conditions of extreme poverty, by high labour force underutilization and, as a consequence, by a high percentage of the Latin American population suffering from malnutrition.

In accordance with the most recent calculations referring to seven countries which together represent nearly 80 per cent of the population and slightly over 90 per cent of the product of Latin America (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela), it is estimated that in 1975 the richest 10 per cent of the households were receiving slightly more than 47 per cent of the total income, while the poorest 40 per cent of the households did not even receive 8 per cent. The high degree of inequality revealed by these figures becomes even more striking if the average incomes of the two groups are compared, for the average income of the first group was over 24 times that of the second group in 1975. Furthermore, between 1960 and 1975 inequality, far from being attenuated, increased in that the share of the income received by the poorest 40 per cent of the population fell slightly and the share of the 10 per cent of the population in the richest group and that of the 20 per cent in the group just below the richest rose slightly.

The statistics on the number of people living in extreme poverty are no less disappointing. Nineteen per cent of the Latin American population lived in extreme poverty, that is, could not have the minimum calories intake, in 1970 and 40 per cent of it was below the absolute poverty line in that it could not satisfy basic housing, education and health needs. In absolute terms those percentages amount to 54 and 113 million, respectively. In terms of percentages, that situation was an improvement if compared to 1960, for by that time more than half of the Latin American population was defined as poor and a quarter of it was extremely poor. Indirect estimates for 1978 suggest



that the situation has continued improving in relative terms, but that one third of the population of the region still has incomes below the poverty line. Furthermore, the absolute number of people living below that line has not changed since 1960.

As is all too well known, poverty situations are connected with unemployment and underemployment. It is estimated that in the region as a whole unemployment and underemployment affect the equivalent of 28 per cent of the economically active population. It is highly probable that this situation has worsened since the mid-1970s, on account of the faltering economic growth rate in numerous countries. Open unemployment is very high in many countries. Much larger, however, is the proportion of the population that is underemployed or receives an income below a given minimum. This population is estimated at 22 per cent, more than half of whom live in rural areas. Naturally, the structure of poverty situations is to some extent similar to that of unemployment.

Because these problems remain unresolved, no less than 15 per cent of the Latin American population - approximately 50 million people - suffer from malnutrition, according to an estimate which in all probability is conservative if account is taken of the proportion of the regional population living in absolute poverty.<sup>11/</sup>

#### Changes in life-styles

Together with the above-mentioned changes, Latin America has been experiencing in the last decades profound changes in styles of life and in consumption patterns. These changes are closely related to and partially explained by the increasing urban character of Latin American society, by the growth of the middle strata, by the tertiarization of the labour force, by the monetarization of rural economies, and by the expansion of the mass media. However, all these have been mostly facilitating factors for the adoption by all but the most deprived social classes of a consumerist ideology which originated in the fractions of the upper and middle strata more in contact with the life-styles and consumption patterns predominating in the developed countries, and diffused from them to the other social strata.

The presence of new life-styles is first of all and more easily perceived as changes in consumption patterns. For instance, a recent study on the subject <sup>12/</sup> found that in urban contexts the use of durable goods extended practically to the whole middle class and to substantial sectors of the lower classes and that, although less widespread than in the cities, the purchase of durable goods had also diffused widely among the rural population. The same study shows that the purchase of goods of that type is relatively independent of short-term variations in family income or of the degree to which supposedly more basic needs have been satisfied.

Another indication of the internalization by most social strata of the new consumption patterns is given by savings behaviour. The scant information available shows that indebtedness through installment payments extends right over the middle, lower-middle and lower strata living in large cities. At the



same time, there seems to be a clear correlation between the more or less modern nature of the context to which the family unit belongs and its savings behaviour. A study done by ECLA <sup>13/</sup> found that in the big cities such as Sao Paulo and Caracas, the relative percentage of saving in relation to income received was less than that recorded in smaller urban localities and in rural contexts. The same applied to the relationship between expenditure and indebtedness, whereas in the bigger cities income was 10 per cent below total expenditure, in more backward (rural) localities saving was 10 per cent more than monthly income. In other words, the closer families are to the diffusion centres of the consumerist ideology the more their savings behaviour will reflect the adoption of such ideology.

New consumption patterns are closely related to other perhaps more long-lasting ones in family organization and in basic motivations towards the family and children which have drastically changed the trends of population growth prevailing until the middle of the 1960s.

#### Style of development, life-styles and population growth

The growth rate of the total Latin American population reached its peak in the mid-1960s and it has declined rather rapidly since then; from an annual rate of 2.9 per cent in 1960-1965 it fell to 2.4 per cent in 1980-1985, and it will probably fall to 2.1 per cent in 1995-2000. In other words, the rate of growth would experience a 28 per cent decline from 1960-1965 to the end of the century. The projections for the years 2000 to 2025 indicate an even steeper decline.<sup>14/</sup>

As is well known, these regional averages are hiding wide inter-country differences. There are countries like Argentina and Uruguay that in 1960-1965 had growth rates lower than those the region as a whole will have at the end of the projection period and that will experience much slower rates than the Latin American average. On the contrary, in Chile, Colombia, Costa Rica, Cuba, the Dominican Republic, Panama and a little later Brazil and Mexico, the decline in the rates of growth have been faster than the Latin American average. Finally, there are countries where rates of population growth have not yet reached a peak (Bolivia, Haiti, Peru) and others whose rates will continue to be stable or decrease very slowly for still some time.

The slowdown of population growth is the result of changes in mortality and fertility experienced by the region. For Latin America as a whole life expectancy at birth increased from about 52.3 years in the period 1960-1965 to 63.94 in 1980-1985. Whereas in the period 1950-1955 there were 12 out of 20 countries with a life expectancy of less than 52 years and only two (Argentina and Uruguay) in which the index was over 60, the change in the situation has been such that today there are 15 countries with a life expectancy of 60 years and over and only one (Bolivia) where it has not reached 52.

The rapid survivorship gains experienced by most Latin American countries since the Second World War has led to the expectation that they will continue in the future, although at a diminishing rate as life expectancy approaches a biological ceiling. However, there are now some indications that the slowdown in the mortality decline started to occur earlier than expected in a number of



Latin American countries.<sup>15/</sup> That slowdown is compatible with the great differences in life expectancy of various social groups and of different regions within a country which are found in the region.

On the whole, although the most recent studies on mortality have confirmed the persistence of wide regional differences within a country, all of them show that mortality differences by social groups are the most marked. At the same time, present evidence shows that the groups most seriously affected by the probability of dying at childhood, and the greatest disparities between social groups, are frequently found in the cities.<sup>16/</sup>

The general decline in mortality experienced by the region is mainly due to a decrease in the number of deaths caused by respiratory, infectious and parasitic diseases. Differences in the incidence of these causes of death in the various social groups, associated with nutritional deficiencies, seem to be the reason for the greater or lesser life expectancy at birth of the members of these groups. Furthermore, in all likelihood the country's heterogeneity in the levels of excess infant and child mortality is also due to the disproportionate weight of these diseases in some countries. Since these diseases are the ones most dependent on the levels of living of the population, it appears that some Latin American countries have already reached a level of mortality where future gains will require that improvements in preventive and curative health be accompanied by a rise in the standard of living of the most deprived regions and social groups. Inasmuch as income continues to be highly concentrated and large fractions of the population remain below the poverty line, the slowdown of mortality decline may become more acute. The inability of the dominant style of development to improve the income distribution and to reduce extreme poverty has in all probability led to slower population growth because of higher than expected mortality.

The actual decline of population growth in the region is due to drops in fertility. As a general rule, it may be said that all countries in which fertility started declining more significantly during the 1960s and early 1970s have experienced very rapid drops. Fertility started declining rapidly during 1960-1965 in Chile, Colombia, Costa Rica and Brazil. These estimates indicate that total fertility rates <sup>17/</sup> are now, respectively, 40 per cent, 43 per cent, 57 per cent and 37 per cent lower in these countries than at the beginning of the 1960s. In the Dominican Republic and Panama the most pronounced drops started during the second half of the 1960s and they have also been very rapid: 41 per cent in the first case and 91 per cent in the second. In Cuba a baby boom from 1959 to 1964 marked the early years of the revolution, but fertility started declining rapidly around 1965, to reach today the lowest fertility level registered in Latin America and less than half the level it had during 1965-1970. Finally, Mexico has been a latecomer in the process of fertility decline, but the drops occurring during the 1970s and early 1980s amounted to 22 per cent of the level at the beginning of the 1970s.

To be true, there is not at this moment a generally accepted explanation of the factors and processes explaining the rapid change of fertility in a number of Latin American countries.<sup>18/</sup> Nobody questions now that family planning programmes have played a role in changing motivations towards family



size and in providing the means for its control, but it is also recognized that they would have been unsuccessful had it not been for more basic social and economic changes leading to preferences for smaller family sizes. On the other hand, it does not seem possible to explain such large and sudden drops of fertility simply as an expansion of sectors that already had lower fertility at the beginning of the decline, or by changes solely in the fertility behaviour of those sectors. What needs to be explained is a change in motivations and attitudes towards children and family size which has affected most urban strata and an increasing proportion of the rural population. Within the limits of this paper and without attempting to solve problems here requiring considerably more research, it is possible to enumerate a number of factors that have unquestionably contributed to such a change.

Some of them are the well-known processes of urbanization, of increase in educational levels, particularly of women, and of changes in female labour force participation towards occupations in the secondary and tertiary sectors where the incompatibility between the roles of mother and of worker is stronger than in agricultural work and in other traditional female occupations. All these processes contribute to a decline of fertility whatever the particular style of development might be. However, differences in development styles are important in that they in great part determine the degree to which all social groups benefit from educational improvement, and the opportunities open for women in occupations different from the traditional ones. As was mentioned, Latin America has been experiencing considerable improvements in educational opportunities and higher degrees of urbanization, together with more or less radical changes in the occupational structure and a rapid expansion of the middle sectors. All these structural changes have no doubt contributed to the decline of fertility.

However, these factors are by no means sufficient to explain fertility declines. In fact, the nature of the style of development adopted by most Latin American countries has been such that only a small - although increasing - number of people participate directly in the benefits of economic development. While these people have changed their fertility patterns, similar changes are sometimes found in social groups and regions only marginally touched by those benefits and even among others that have suffered some deterioration of their living standards. It is, therefore, necessary to broaden the spectrum of factors which might help to explain these changes.

In all probability, the style of development being followed by the Latin American countries has, for different reasons depending on their structural position, tended to accelerate changes in motivations and attitudes towards children and family of most social strata and not only of those most benefitted by it.

The relationship between the adoption by the middle classes of new life-styles and consumption patterns, and preferences for smaller families has already been mentioned. The new patterns and a consumerist ideology have also been diffused to the urban working classes and to growing numbers of small farmers and agricultural wage workers. In these cases, however, structural changes have led to higher subsistence costs for children and the labour force



which have probably contributed to weaken the motivation for large families. Besides, more deprived lower-class urban groups have also been motivated to have a smaller number of children by their inability to provide for their offsprings' basic needs. To all these factors it must be added that in some countries the implementation of development policies and strategies oriented to make national development patterns more compatible with the now dominant transnational development style has lowered the real wages of the working classes, thus putting more constraints on the motivation for additional births. In other words, birth control (abortion included) would have become part and parcel of either the social mobility strategy of some urban and rural strata, or the survival strategy of others.

Structural and short-term changes linked to the degree of development reached and to the style of development adopted plus the diffusion of a consumerist ideology and of new consumption habits, and the implementation of public and private family planning programmes, would then be pushing towards changes in fertility-related motivations and attitudes which, together with a much wider availability of contraceptives, would have led to a rapid decline of fertility in the countries where the majority of the Latin American population lives.<sup>19/</sup>

One important consequence of that drop of fertility has been that the rate of population growth is now slower than the rate of growth of agricultural production. The most conservative forecasts of agricultural production from today to the year 2000 estimate that agricultural output will grow at faster rates than population.<sup>20/</sup> If there are no deliberate policies or changes in the international scenario capable of altering the past and present trends, agricultural output may grow at 3.1 per cent annually, that is between 6 and 10 percentage points faster than the growth of population. At the same time it must be borne in mind that in 1975 the average per capita supply of calories was already 6 per cent higher than the estimated minimum requirement of 2,400 calories a day. Assuming the projected trends in population growth and that the trends in agricultural production are not altered from today to the year 2000, the average per capita supply of calories will be 2,888 a day for the region as a whole by the end of the century.<sup>21/</sup> It can therefore be concluded that the problems of malnutrition found in the region are not derived from insufficient output or from a population that grows faster than food production, but that they are the consequence of distortions provoked by the dominant development style in income distribution and, therefore, in the consumption capacity of different social groups, as well as in their consumption preferences.

#### Style of development and urbanization patterns

The emergence of the style of development described above has coincided with a period in which Latin America has become a predominantly urban region. According to the last estimates made by the Latin American Demographic Centre (CELADE), 57.61 per cent of the total Latin American population was urban in 1970. Between that date and 1980, 65 million more people were added to the urban population, making it reach 64.43 per cent of the total regional population. The addition of 178 million more from 1980 to the year 2000 will



mean that more than three fourths of Latin American inhabitants will be urbanites by the end of the century.<sup>22/</sup> Moreover, the secular high degrees of population concentration in the great metropolitan areas has increased in recent periods, as shown by the fact that the proportion of the population residing in urban places of 20,000 and over inhabitants rose from 9.2 per cent in 1950 to 22 per cent in 1975, due to an increase from slightly more than 40 million in 1950 to 142 million in 1975.<sup>23/</sup>

The question is whether the emergent transnational development style has accelerated or slowed those secular trends. The information available is scant but it suggests that in most cases up to at least around 1970 the degree of concentration of the industrial product and of the demand for labour force was increasing in the largest metropolitan centres,<sup>24/</sup> but that in all the countries analysed the size and the participation of smaller localities in total employment had also increased. A number of factors have contributed to this. In some cases - Brazil being the most noteworthy example - smaller cities have grown as a consequence of the development of a more complex interurban division of labour which has introduced differences in the occupational profiles of cities of different sizes. The emergence of market poles and services poles has allowed in those cases a dispersion of the urban population together with a higher concentration of the most modern industrial activities in the largest metropolitan areas. However, this seems to be a very exceptional case in Latin America. More often the growth of smaller urban localities is in part explained as the result of investment allocations made by transnational corporations or their national associates attracted by the proximity of natural resources. In other cases small urban places grow as a consequence of the expansion of the agricultural frontier and of changes in the organization of agricultural production. Finally, there are cities and towns that grow at least for some time due to governmental regional and urban development policies. One or a combination of the above factors have led to the emergence of what has been called "centres of explosive growth" in Latin America, highly vulnerable to decisions taken in the main metropolitan centres and characterized in most cases by acute shortages of basic services and very disparate levels of living.

At the same time all seems to indicate that although the concentration of the urban population in the metropolitan areas of the capital cities has declined in some countries (Argentina, Peru, Uruguay, Venezuela) and in another (Chile) it has remained stable, all of them are facing higher concentrations in the macro-regions where the capital cities are placed. In fact, since the emerging transnational styles have reinforced their role as the seat of the most important political and economic agents (both multinational and national), as producers of economic surplus and as recipients and beneficiaries of the surplus produced by other national regions, it seems difficult to expect a change in the trend towards higher population concentration in the metropolitan macro-regions without significant modifications of the now dominant style.

The rapid and massive process of urbanization and metropolitanization characterizing Latin American patterns of population distribution would have affected the ecosystems and the use of resources whatever the style of development might have been. There are, however, some social and



environmental consequences more directly related to the transnational style that must be briefly mentioned. First, the metropolitan areas are expanding geographically at a faster rate than the growth of their population, as a consequence of the construction of both very exclusive residential neighbourhoods in some sectors and of shanty towns in others. This unnecessary expansion has been to the detriment of the arable land surrounding the cities and has raised considerably the investment costs of infrastructure. This pattern is related to the predominant role played by financing and banking firms in real estate and the consequent increase in the price of metropolitan land. Associated with big construction firms, they also control the building and housing market and concentrate housing production on meeting the needs of the upper and middle classes, leaving unsatisfied those of the poorer strata where housing shortages are more acute. Governmental efforts to fill the void left by private firms and to reduce those shortages have been insufficient to avoid the rapid expansion of the shanty towns characterizing the peripheries of most if not all Latin American large metropolises.

The inability of the Governments to keep pace with the rapid growth of socially and ecologically marginal intra-metropolitan areas and to reduce the existing deficits in housing and infrastructure has contributed to the permanence of very poor sanitary conditions in those areas. The health problems derived therefrom are aggravated by a medical practice which has, in general, followed the specialization patterns of the more developed countries and is concentrated on meeting the health needs of the upper and middle classes. Although governmental health services make efforts to fill the void left by private practice, those efforts have been insufficient to provide for adequate health care to the poorer social classes. The high cost of medicines and drugs produced almost exclusively by transnational pharmaceutical firms aggravates even further the disadvantaged position of the lower classes vis-à-vis that care.<sup>25/</sup>

None of these social and environmental consequences of metropolitanization are due to the rapid growth of the metropolitan areas as such, although this factor may aggravate and make more evident some pre-existing problems of the region.<sup>26/</sup> On the other hand, these problems are not deterring migration to the metropolitan areas. Contrary to the pessimistic view about the possibilities urban migrants had to improve their lives in the cities that prevailed some years ago, there is now abundant evidence that migrants are no more disadvantaged than metropolitan natives regarding economic and social opportunities and do not suffer from serious social and psychological maladjustments to their new environment.<sup>27/</sup> On the contrary, migration to the metropolitan areas gives those born in smaller urban places and in rural areas more opportunities than at their places of origin to participate in the sophisticated and diversified metropolitan consumer market. In other words, geographical mobility to the big cities is perceived by poor migrants as social mobility despite the social and ecological segregation they will have to share with the native members of the poorer social strata.

The interrelations of urbanization and the environment as an aspect of development include not only metropolitan areas but also smaller urban centres. Although these interrelations are less prominent when they take



place in smaller towns, recent studies have called attention to the fact that the emergence of centres of "explosive" growth and of growth poles have had strong negative impacts on the local ecosystems. Besides, many of these seem to be plagued by even more acute manifestations of the problems usually considered to characterize only larger centres: high unemployment rates, urban segregation, marginality and infrastructural deficits.<sup>28/</sup> The information available on the problems at this level is scant but sufficient to highlight the need to devote considerably more attention to it in the future, both because it might help to identify better some up to now vaguely perceived social and environmental problems and because an important segment of the migrants to the large metropolitan centres is composed of former residents of those towns that were pushed out by these problems. At the same time, scant as it is now, the information on the social and environmental problems faced and provoked by medium-sized and small towns has served to reinforce the consensus reached by Latin American experts that there is no necessary relationship between the degree of concentration and the degree of environmental deterioration, and that the distribution of the cost and benefits derived from environmental change depends more on the general style of development than on the size of the urban centre or the speed of its growth.<sup>29/</sup>

Stability and change of life-styles, the environment, and  
demographic dynamics in rural Latin America: some selected cases

There are three main processes taking place in the rural areas of Latin America: (a) the expansion of commercial agriculture organized as capitalistic firms and the consequent increase in the number of agricultural wage workers; (b) the survival of peasant agriculture in areas where it has traditionally been important; and (c) the expansion of the agricultural frontier. The last two processes have been subject to study by ECLA from the perspective of their implications for the levels of living of the populations involved and of their interactions with selected environments.<sup>30/</sup> Although both are very closely related since in great part those who move to frontier areas are peasants from traditional areas and the processes taking place in one affect the other, there are advantages in dealing with them separately.

Population and peasant survival in high-altitude ecosystems

The Andean countries are among those where the number of peasant productive units not only has increased considerably through time, but has done so at a higher rate than agricultural wage work. Estimates for eight Latin American countries, including those of the Andean region, indicate that between the middle of the 1960s and the middle of the 1970s the number of single family productive units, usually considered as an operational definition of peasant holdings, experienced a 38 per cent increase as a consequence of subdivisions, of agrarian reform programmes, and of the expansion of the agricultural frontier.<sup>31/</sup> At the same time, peasant labourers, i.e., those classified as independent workers and as unpaid family workers by the census, had higher rates of growth between 1960 and 1970 than agricultural wage workers in Bolivia, Ecuador and Peru, <sup>32/</sup> among other countries.



To its quantitative importance must be added the economic importance of peasant production in the Andean region. Between 50 per cent and 60 per cent of the goods for final consumption are produced by owners of less than five hectares, and no less than 30 per cent of the total amount of cattle is owned by peasants.<sup>33/</sup>

The high altitude ecosystems of the Andean areas are environments for which no major technological improvements have been made. They have very limited resources of organic matter and energy which have been possible to use intensively only by resorting to a complex and coherent system of social organization. The principles of reciprocity, the communal institutions created for the utilization of natural resources, the principle that each family and community should have access to different ecological floors, the participation of all family members in productive activities are, among other things, some of the mechanisms used by peasant families and communities to survive under different historical circumstances in such an environment. Although the origins of the system of social organization that characterizes those communities date back to the pre-Columbian period, the system has up to now proved to be both very stable and highly adaptable to changing social, economic and environmental pressures. The partial but increasing integration of peasant families and communities into the modern socio-economic system prevailing in the national societies where they live is, however, posing new challenges of far-reaching consequences for the future of those societies.

Agrarian reform programmes, the modernization of large farms and the concomitant internal changes of the communities have accelerated during the last 15 to 20 years the direct integration of highland communities into the national and the international economic system. The production of commercial crops, a more common participation of their members in the wage labour market, the limited but increasing incorporation of industrial inputs in the production process, the use of commercial loans and the purchase of manufactured goods are all expressions of a much wider direct integration of those communities into an urban-industrial economic system. Moreover, the acculturation to consumption patterns and life-styles dominant in the cities has also increased. However, surveys about peasant motives and attitudes reveal that changes in consumption habits and in life-styles are in great part adaptations to a new economic and socio-cultural environment and do not necessarily imply the complete disappearance of traditional culture and social organization. On the contrary, all seems to indicate that Andean peasants, very far from being a mass of individuals eager to leave their land and to abandon completely their culture, move either to agricultural frontier areas or to the cities mostly as part of a family and community survival strategy.

Two interrelated sets of processes help to explain changes in Andean peasants' consumption habits and life-styles. The first has an external origin and could be labelled the diffusion of Western urban culture to the countryside. The progress made in basic education, the extension of highways and paved roads, the expansion of communication networks as well as the influence of mass media and commercial advertising, higher degrees of urbanization, and more geographical mobility of the younger generations have certainly played an important role in such changes. But at the same time, the increasing integration of peasant families and communities into a market



economy and their changes in consumption patterns and life-styles are also part of family and community survival strategies adopted as a response to the atomization of their holdings provoked by social, environmental and institutional constraints.

Although there is no direct measurement of the components of demographic growth of the peasant population, there is little doubt that its annual rate of increase has been slower than that of the national population and of most if not all other social groups. This slow rate is not due to low fertility since, although lower than in other rural areas, it is still high, but to outmigration and to very high rates of general and child mortality. However, contrary to what used to happen in the past, that growth is nowadays constant and sustained in the majority of peasant communities. The abolition of serf-like relationships and of compulsory work has served to avoid the drastic fluctuations in the number of peasants which apparently characterized the past, while at the same time governmental epidemic control campaigns have served to decrease contagious diseases, and improvements in transportation systems have made it easier to reach medical posts in case of serious illness. Though slow, the resulting demographic growth of peasant populations encroached by commercial farms or living in areas where all potentially arable land is already under cultivation and with very limited access to financial resources and modern technology inputs has served to increase the fragmentation of peasant holdings and has contributed to a general impoverishment of the Andean peasantry. In Peru, for instance, the average size of small holdings (less than five hectares) was 15.3 per cent smaller in 1970 than in 1960 and in Ecuador it was 13 per cent smaller.<sup>34/</sup> In Bolivia a study of four highland haciendas showed that they had doubled in size since 1953.<sup>35/</sup> The mean size of the land tilled by highland peasant families in 1975 fluctuated between 0.93 hectares in the north and 1.35 hectares in the central area.<sup>36/</sup>

The survival strategies adopted as a response to the atomization of peasant holdings include a number of interrelated components. One of them is more intensive land use without technological improvements. The analysis of the data available shows that a reduction in the size of the productive units leads to a larger number of annual crops due to faster cultural rotation, to the reduction or elimination of fallows, and in some cases to the inclusion as harvested areas of some that were previously considered unproductive. In Bolivia this response has caused the area harvested by peasant families to increase by almost 60 per cent between 1950 and 1974-1976.<sup>37/</sup>

A second component of such survival strategies is the adoption of modern technologies and the acceptance of changes in deeply rooted production habits. Studies in different Andean regions confirm that, far from opposing innovations, peasants incorporate improved seeds, chemical fertilizers and pesticides, and that they are willing to change sowing techniques whenever those changes are considered to be necessary to reach what they consider their normal subsistence level. In fact, if peasants do not use more technological inputs, it seems to be due mostly to their lack of cash income and not to tradition.



A third and most central component of the strategies peasant families use to survive is the diversification of sources of income. Among those sources are commercial activities and crafts. In most cases these activities are seen as providing complementary income to that derived from agricultural production, but there are cases in which peasants earn practically no income from agricultural activities and devote almost all their time to crafts and commerce. Another source of income comes from selling their agricultural and cattle production in the neighbouring markets. The degree to which this is possible depends on agro-ecological conditions, family size and access to the markets. A higher proportion of peasant production is sold when agro-ecological conditions are favourable for crops not used for direct consumption by the producer and his immediate family. Unfortunately, this is rarely the case in the Andean highlands where the main crops are wheat, barley, quinoa, potatoes and corn. In those regions it is difficult to sell more than 25 per cent of agricultural production, thus leaving peasants with very little opportunity to earn by this means the cash income they need to purchase more suitable technological inputs. Family size is another factor affecting the proportion of marketed agricultural production. Generalizing from a number of surveys, it is possible to say that the smaller the family size the higher the proportion of peasant production sold in the market and the higher the proportion of it that is left to be used as seeds next year. This makes it even more difficult for highland peasant families to earn cash income from agricultural activities alone, although the expansion of highway networks has considerably improved access to markets in recent years.

In general, the smaller the size of the peasant holding, the larger the proportion of family income earned through wage work outside the family farm. Temporal migration of one or two family members is one way of raising family income. Remittances either in cash or in durable goods and food items from the migrant son or daughter provide another way of satisfying family needs. Finally, the whole family may be forced to move to a city or to an agricultural frontier area.

Despite the efforts of peasants and Governments, the levels of living of the peasant population in the highlands seems not to have improved. Calorie intake, for instance, is still below the minimum considered normal (2,400 calories daily). In areas of the Bolivian highlands it has been found that the daily calorie intake is no more than 1,802 calories, and that in some places it reaches only 1,325 calories per person. By contrast, in the same country per capita calorie consumption has increased from 1,624 in 1950 to 2,206 in 1975.<sup>38/</sup> Besides, in all highland areas peasant productivity has decreased and soil deterioration has increased.

The above problems of social, economic and ecological deterioration have coincided with relatively low rates of natural population growth, due to very high mortality and to comparatively low fertility. The lack of basic services and the very low income level of most of the peasant population have served to keep mortality levels considerably higher than in other social groups of the same countries. In Bolivia, for instance, the children of highland peasants had a probability of dying before two years of age from 256 to 264 per thousand in 1975, depending on their relative proximity to an urban centre, while only 129 out of one thousand children of the upper middle strata living



in the main cities would die before that age.<sup>39/</sup> In Ecuador, Behm found that the probability of dying before two years old was 37.8 per cent higher for the children of the Indian population living in the highlands, most of them probably peasants, than that of the non-Indian population living in those areas.<sup>40/</sup> In Peru, infant mortality in the rural areas of the highlands was considerably higher in the period 1977-1978 (146.3 per thousand) than among the rural population of the coast (112.2 per thousand).<sup>41/</sup>

On the other hand, highland peasants have high fertility levels but they are lower than those of other rural groups. In Ecuador, for instance, the National Fertility Survey conducted in 1976 found a mean of 4.87 children ever born to peasant women 15-49 years old (standardized by age and duration of marriage) living in the highlands, while coastal peasant women of the same ages had an average of 5.37 children.<sup>42/</sup> In Bolivia, a detailed analysis of the 1975 census led to the conclusion that fertility levels were high and increasing in all agricultural groups, but again that highland peasant women had lower levels than those of the agricultural frontier areas.<sup>43/</sup> In both cases the available evidence suggests that such comparatively low fertility can be attributed to a larger breast-feeding period among Andean women due to a social organization of production which allows women to work while being in close contact with their children, as well as to lower nuptiality due to selective outmigration of young male adults.

The fact that the deterioration of social, economic and ecological conditions in the Andean highlands has occurred despite comparatively slow rates of population growth is an indication that the problems faced by the population of those areas are caused not so much by demographic factors as such but mostly by structural and institutional factors. Accordingly, the solution to those problems requires urgent institutional and technological changes aimed at improving agricultural output and at opening more employment opportunities in those areas. However, in cases of high population density planned migration to agricultural frontier areas might be a necessary complement to such changes.

#### Expansion of the agricultural frontier: some demographic and environmental consequences

The expansion of the agricultural frontier is undoubtedly one of the most noteworthy trends in Latin American agricultural development. Growth in agricultural production has been and continues to be based chiefly on an increase in area harvested. In the 1960s the expansion of this area accounted for two thirds of the increase in the harvest, and the remaining third was accounted for by higher yields. Although productivity is making increasing contributions to the total produced, three fifths of the expansion of agricultural productivity during the 1970s was still accounted for by a more extensive area harvested.<sup>44/</sup> In the past decade, the regional area harvested has risen from 85 million hectares to 100 million hectares. Most of that increase has been concentrated in Bolivia, Brazil, Costa Rica, Ecuador, Mexico, Panama, Paraguay and Venezuela. Of all these countries Brazil is the most striking case when the process is viewed in a longer perspective: during the 15-year period between 1950 and 1975, the area harvested increased from



17.5 million hectares to 42 million hectares, and has continued increasing since then.45/

The noteworthy expansion of the agricultural frontier has raised three interrelated questions: its demographic effects for the country as a whole and for sending and receiving places; the economic and social conditions under which it takes place; and the environmental consequences for the frontier as well as for other areas.

Migration flows to frontier areas fulfil a number of important functions within the predominant development style. For the rural population of consolidated areas they are a means to escape from unemployment and land scarcities produced by the increasing dominance of market-oriented capital-intensive agricultural firms in their areas of origin, as well as to avoid long periods of unemployment in the cities. For the Governments, to encourage spontaneous settlements and organize government-sponsored settlement schemes are ways of raising farm production without politically dangerous structural changes in the land-tenure system, and to alleviate social pressures in the cities. Finally, frontier settlers allow the expansion of capitalistic firms by first performing the tasks involved in opening up operations and later providing the necessary labour force.

From the demographic perspective, the population redistribution effects attributed to the expansion of the agricultural frontier are one of the main reasons why Governments encourage and/or organize land settlement schemes. Some information from Bolivia and Brazil will allow us to have an idea of the degree to which that function has been actually accomplished.

Until 1952 most of the Bolivian population resided in the highlands and valleys where the indigenous population had lived for centuries. The abolition of landowners-peasants dependency relations by the agrarian reform of 1953 allowed the peasants freedom of movement at a moment when the Government was encouraging the development of the eastern areas of the country in tropical savannahs. As a consequence of these two factors and of high population pressure in the area of traditional peasant agriculture, massive eastern-bound population movements have been taking place during the last 30 years. Between the last two population censuses (1950 and 1976), the rural population of the eastern region increased at an annual rate of 3 per cent while the population of the highlands and valleys barely grew at a 1 per cent rate.46/

Despite these differences in rates of growth, 80 per cent of the Bolivian population continued to live in the highlands and valleys in 1976. Studies done by the Bolivian Ministry of Planning indicate that to keep stationary the rural population of those regions, around 3 million people would need to migrate from them between 1980 and 1985 and 2020 and 2025, 60 per cent of which would have to move to the eastern plains.47/

In Brazil, the expansion of the agricultural frontier has been viewed by recent Governments as a safety valve for conflicts derived from structural unemployment and as a way of increasing farm production without major changes in land-tenure systems. During the last 20 years that role has been assigned to the Amazon area.



A recent study of preliminary data provided by the 1980 Brazilian population census 48/ allows some tentative conclusions as to the degree to which the expansion of the Amazon frontier has fulfilled government expectations. Between 1970 and 1980 Rodônia, one of the states composing that area, had a rate of population growth of 15.8 per cent annually, by far the largest rate of all Brazilian states. Furthermore, the Amazonia region had during the same period the fastest rates of growth of all regions: 5 per cent annually, or twice the national rate of growth. If these rates give the impression that the Amazonia has fulfilled its population redistribution role, a look at the absolute numbers of migrants leads to the opposite conclusion. The total number of migrants to the Northern region during the 1970-1980 period has been estimated to be 915,000 people and no more than 500,000 are estimated to be migrants from other regions to the Amazonia rural areas. In contrast, it has been estimated that to absorb the structural over-population found in other regions, Brazilian agricultural frontier areas would need to receive 2.4 million more families.49/

In sum, both the Bolivian and the Brazilian experiences do indicate that the expansion of the agricultural frontier is significantly contributing to resolving social pressures in other regions or is having important population redistribution effects at the national level.

The Brazilian experience illustrates the importance of economic, social and technological factors operating in the agricultural frontier areas with respect both to their capacity to attract and retain population and to the ecological problems derived therefrom. The Paraná and centre-west regions of that country were, until the 1960s, those with the highest net migration. Provisional data from the 1980 population census show that in the former there were one and a half million more outmigrants between 1970 and 1980, and that net migrants were only 736,000 in a population of seven and a half million in the latter. Students of the subject agree that such a sudden reversal of previous trends is related to changes in crop composition and to the adoption of a style of development giving priority to agricultural production based on mechanization rather than on a permanent labour force. This new style of agricultural development has modified the relations of production and has forced tenant farmers and "renters", as well as former permanent wage labourers, to become seasonal wage labourers with an urban residence, to try to find work in the cities, or to move to new frontier areas.

Studies of recent social and economic changes in Rodônia 50/ indicate that processes similar to those of Paraná and the centre-west region are now taking place in that Amazonian state, and that it is highly probable that the expulsion of small farmers may be even faster than in those regions.51/

Although the problems faced by Brazilian frontier settlers are not completely general to other frontier areas, there are indications that in most of them the organizational and technological model applied to agricultural activities tends to replicate those of the consolidated agricultural areas, though they have very different ecological characteristics.

Where they are found, atomization of holdings, landlessness, lack of permanent work, marginalization, and the resulting widespread poverty are



derived more from the structural technological and institutional characteristics of the expansion of the agricultural frontier than from demographic factors. However, it is useful to remember that the frontier areas have comparatively high rates of natural population growth due to fertility levels higher than in other rural areas.

Higher nuptiality due to the predominance of male migration and hence to high sex ratios seems to be particularly important in explaining such fertility. Furthermore, it is possible that migrants have higher fertility than non-migrants, that the breast-feeding period is shorter, and that other traditional controls of fertility-related behaviour have been weakened in frontier areas. In a more speculative vein, it has also been argued that higher fertility in those areas is a demographic response of frontier migrants to land availability.<sup>52/</sup>

On the contrary, mortality levels are surprisingly low among Bolivian and Brazilian frontier settlers. While 3 out of 10 children die before their second birthday in Bolivian areas of consolidated agriculture, only 1.9 children being born in the frontier areas of the Eastern Meadows share that fate.<sup>53/</sup> In Brazil, life expectancy at birth of the Amazonian population was about the same as the national average but it has increased more rapidly.<sup>54/</sup>

Migration and comparatively high rates of population growth combine and reinforce each other to make the rural population increase at very high rates. Population densities in those areas are still low but the organization of large farms has severely restricted access to land, while mechanization and seasonal wage labour make it difficult to find permanent jobs in the agricultural sector. Spontaneous occupations of poorer soils, invasions of Indian lands and of forest reserves, return migration to the cities, growth of urban centres populated mostly by migrants trying to obtain land or to be hired as seasonal wage labourers and with very poor health and educational services, are some of the consequences of these processes.

The environmental consequences of the expansion of the agricultural frontier are not well known at this moment.<sup>55/</sup> However, preliminary results of a study being conducted by the ECLA/UNEP Project on Styles of Development and Environment indicate that in the next five years 294,340 square kilometres will begin to be incorporated into the harvested areas of South America, and that at least 66 per cent of the expansion of the agricultural frontier will take place in areas where the ecological impact will be high. Most of that expansion will take place in the Amazon ecosystem.

The expansion of the agricultural frontier will continue to be an important way of increasing agricultural production in the region. The question is whether and how the ecological costs may be reduced and the social and economic benefits may be sustained in the future. The Brazilian experience suggests that an increasing number of small farmers encroached on by large farms will provoke considerable ecological damage in their attempt to obtain more land, but that the damage derived from the activities of large ranches and of agro-industrial corporations may be even more serious. At the same time, it shows the need for Governments to include ecological considerations in the formulation and implementation of policies if environmental costs are to be reduced.



### Major guidelines for future action

The objective of this paper has been to illustrate how the demographic dynamics of Latin America during the last two decades and some environmental problems are related to the specific productive structures and consumption patterns prevailing in most countries of the region, or in specific regions of them. A number of structural changes derived from the adoption of a style of development characterized by the dominant role assigned to transnational corporations in the key productive sectors and in financing and services were summarized in the first part of the paper, to be later related to the main trends of Latin American demographic change.

A first general conclusion derived from that analysis is that the above-mentioned changes have served to accelerate the decline of fertility but that at the same time they have maintained very unequal probabilities of dying during the first years of age, depending on social origin and place of residence, and that it is quite probable that survivorship gains might have experienced a slowdown earlier than expected. From a policy viewpoint, this conclusion suggests that future drops of mortality levels will require a combining of preventive and curative health measures with decisive efforts to reduce extreme poverty. The studies done by ECLA indicate that most Latin American countries have already reached a level of economic and institutional development allowing for the elimination of extreme poverty if there is the political will to do it.

A second conclusion is that the now dominant style of development has not and in all probability will not modify substantially the secular patterns of urban concentration and metropolitanization, and that most of the environmental problems associated with metropolitanization and residential segregation are more a consequence of the style of development and of the stratification system of Latin American societies than of the size of the metropolitan centres or the speed of their growth.

From the political point of view, it appears that the solution to some of the more acute problems of metropolitan development (and the environmental relations involved in it) does not depend on their recognition, which has already been secured, or on technical instruments, which are available, but on the possibility of removing obstacles standing in the way of the implementation of the policies set forth for that purpose. In most cases this depends to a great extent on such factors as the negotiating capacity of the government vis-à-vis the big transnational corporations, the natural resource policies, the technological capacity of the country in key sectors, and the negotiating capacity of the local authority and people.

The second part of this paper has dealt with two related problems: the socio-demographic and environmental problems faced by peasants in high altitude ecosystems, and the population and environmental problems of agricultural frontier areas.

The social and economic importance of Andean highlands peasants makes what will happen to them important not only for them but for the whole society.



The analysis made here and the studies by ECLA on the subject clearly point to the need for devising and implementing new approaches to the work of the Andean rural development organizations. On the basis of a diagnostic study of the management and the social and productive organization of resources in peasant communities, those approaches should promote the increase of their resources and the responsible and equitable management of the micro-regional ecosystems through a communal and inter-community arrangement for popular participation in rural development programmes.

The expansion of the agricultural frontier has in great part been a spontaneous response to social and economic problems faced by the population living in traditional areas of peasant agriculture. Systems and ways of occupying new areas have resulted in major environmental changes at a high social and, probably, ecological cost. The technological model applied to agricultural activities on the frontier has replicated the technological pattern of the consolidated agricultural areas. Often this model tends not to make the best use of the attributes of the ecosystems of virgin areas (water-retaining capacity, recycling, shade, etc.) and brings to bear untenable objectives of maximizing land productivity; moreover, it tends to reproduce land-tenure patterns and labour relations that leave a growing number of people without access to land or to permanent jobs. To avoid these social and environmental costs it is necessary that the Governments review that model, giving special attention to technological changes and to the analysis of the appropriation of surpluses. It will be equally necessary to examine experiences with planned settlements in order to avoid aggravating instead of diminishing these environmental and social costs.

The analysis of peasant economies in high altitude ecosystems and of the social, economic and environmental conditions in agricultural frontier areas, although not covering the whole Latin American agricultural system, has shown the need for the Governments of the region to formulate and implement policies aiming at a modification of the now dominant style of agricultural development. Although even the continuation of that style would make food production grow faster than population, it will aggravate the concentration of land, capital and production. In some ecosystems, it will also provoke the depletion of resources or negative disruptions of an environment for which the techniques involved are not appropriate. In the long run, this would imply the failure of the whole effort deployed to attain a sustainable production from such ecosystems.

### Summary

Beyond specific conclusions, necessarily tentative given the paucity of relevant data, the analysis of the population/styles of development/life styles/environment relationships in Latin America provides some useful guidelines for future action in the field.

The dominance of a development style in which transnational corporations play a central role demonstrates that many apparently local manifestations of the problems of population, resources, environment and development have their cause elsewhere, in distant centres of decision-making, or in a process



triggered by someone else. In fact, a critical part of the interplay of these relationships in the years to come is likely to take place in the industrialized countries. This is so because of the truly global reach of many of their domestic and international policies, and also because they act as centres which diffuse world-wide patterns and systems of production and consumption, transnational life-styles, technologies, etc. Thus, evolving and applying environmentally sound, and energy and natural resource-conserving patterns of development, life-styles and technologies in the industrialized countries is of fundamental importance for the way in which the interrelationships of population, resources, environment and development will evolve in these countries, and globally.

What takes place in the developing countries is not likely to have such great influence world-wide, though in many instances it will be of critical importance for their domestic development. Uncritical assimilation of development styles from the North, the lack of policy sensitivity to the interrelationships, and the absence of effective instruments and experience to deal with them, can lead to possible local breakdowns, and to social, environmental and resource crises in many localities, including some major metropolitan areas of the third world.

Everywhere, integrated/systems thinking, planning, policy and decision-making are a prerequisite for dealing with these interrelationships. In this context, different specific population policies will have a critical role to play. The problem that remains is that decision-makers and institutions still have to learn how to think and act in an integrated and systemic manner, and even more importantly, once they learn to do this, they must learn how to apply it effectively in practice. The gap between the desired schemes, models and plans and the dynamic and unpredictable real world still tends to be considerable.

There are a number of things that could be usefully undertaken internationally, and particularly by the United Nations system, to fill that gap. In the first place, considerably greater efforts will have to be devoted to improve the data base and to elaborate and to follow systematically indicators of the quantitative evolution of the issues involved.

Second, case studies of special instances of the interrelationships of population, resources, environment and development will have to be carried out, in order to increase the understanding and knowledge of the problems involved and to provide solutions to them.

Third, more efforts will have to be devoted to elaborate integrated approaches and understanding of the problems involved, in order to overcome the narrow and unisectoral approaches that tend to slow down progress in working out adequate solutions.

Finally, concentration on those three main tasks will allow the building of better and continuously improved models and for projections that are global and of long-term significance.



Analysing and highlighting the policy implications of these interrelationships from a global perspective is a task uniquely suited to the United Nations, since ultimately the population, resources, environment and development aspects will evolve in the context of the development process as a whole. And, especially as it concerns the developing countries, this process will be strongly influenced by and related to the creation of an adequate material base, and an equitable resolution of the many structural problems inherent in the North-South economic and political relations, including the access to and distribution of natural resources.

#### Notes

1/ The first subject was discussed in a regional seminar on agrarian policies and peasants survival in high altitude ecosystems held in Quito, Ecuador, from 23 to 26 March 1982. The second was the subject of a seminar on the expansion of the agricultural frontier and the environment in Latin America, held in Brasilia, from 10 to 13 November 1981.

2/ See among others, Raúl Prebisch, "A critique of peripheral capitalism", CEPAL Review, (first half of 1976); Enrique Iglesias, "Situation and prospects of the Latin American economy in 1975", Ibid; Aníbal Pinto, "Styles of development in Latin America", Ibid; Marshall Wolfe, "Approaches to development: who is approaching what?", Ibid; Jorge Graciarena, "Power and development styles", Ibid; Osvaldo Sunkel, "The interaction between styles of development and the environment in Latin America", CEPAL Review (December 1980); Comments to Osvaldo Sunkel, "The interaction between styles of development and environment in Latin America", loc. cit., by Aníbal Pinto, Jorge Sábato, Gabriel Valdés and Jorge Wilhelm.

3/ Preliminary estimates by the ILO Regional Employment Programme for Latin America and the Caribbean (PREALC) on the basis of national population censuses (adjusted) and surveys (adjusted). The total includes information from 14 countries which account for around 95 per cent of the economically active population of Latin America: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Mexico, Panama, Peru, Uruguay and Venezuela.

4/ Economic Commission for Latin America, on the basis of UNESCO data.

5/ Carlos Filgueira, "Consumption in the new Latin American models", CEPAL Review, No. 15 (December 1981), p.71.

6/ Food and Agriculture Organization of the United Nations, Agriculture Toward 2000: Latin America's Problems and Options (Rome, February 1981).

7/ Ibid.

8/ Emilio Klein, "Diferenciación Social: Tendencias del Empleo y del Ingreso Agrícolas", Economía Campesina y Empleo (Santiago, Chile, 1981), pp. 3-25.



9/ Economic Commission for Latin America, "Problems and orientations of development", CEPAL Review (December 1981), pp. 47-69; and Economic Commission for Latin America, Division of Natural Resources, Tendencias y Perspectivas del Abastecimiento de Energía en América Latina (1960-1979; 1980-1990), unpublished paper.

10/ Economic Commission for Latin America, Division of Natural Resources, ibid.

11/ Enrique V. Iglesias, "Development and equity. The challenge of the 1980s", CEPAL Review (December 1981), p. 41.

12/ Carlos Filgueira, op.cit.

13/ Economic Commission for Latin America, "Income distribution in selected major cities of Latin America and in their respective countries", Economic Bulletin for Latin America, vol. XVIII, Nos. 1 and 2 (1973).

14/ Latin American Demographic Centre (CELADE), Boletín Demográfico, Año XIV, No. 27, Santiago, Chile (January 1981), table 2-b.

15/ See Valeria Da Motta Leite, "Níveis e Tendências da Mortalidade e da Fecundidade no Brasil a partir do 1940", Table 6, in Associação Brasileira de Estudos Populacionais, Anais Segundo Encontro Nacional, vol. 1 (Sao Paulo, 1981); M. Muller and M. Accinelli, "Un Hecho Inquietante: La Evolución Reciente de la Mortalidad en Argentina", Notas de Población, VI, No. 17, 1978. A. Palloni, "Mortality patterns in Latin America", Population and Development Review, vol. VII, No. 4, 1981.

16/ H. Behm and D. Primante, "Mortalidad en los primeros años de vida en América Latina", Notas de Población, Año VI, No. 16, 1978; G. González, "Estrategias de desarrollo y transición demográfica. Los casos de Brasil, Costa Rica, Cuba y Chile", Latin American Demographic Centre (CELADE), mimeo, 1980; G. González, "Procesos Demográficos y Economía Campesina: el caso boliviano", Latin American Demographic Centre (CELADE), mimeo, 1982.

17/ Total fertility rate is the average number of children that would be born per woman if all women lived to the end of their childbearing years and bore children according to a given set of age-specific fertility rates.

18/ For attempts at explaining some cases, see G. González, op.cit.; J.A.M. Carvalho, P. Paiva and D.R. Sawyer, A Recente Queda da Fecundidade no Brasil: Evidências e Interpretação, Belho Horizonte, Brazil; Centro de Desenvolvimento e Planejamento Regional (CEDEPLAR), Monografía No.12, 1981; the monographs on Brazil, Colombia and Cuba prepared by different authors for the Panel on Fertility Determinants of the National Research Council of the United States; and Martínez Manaoutou, op.cit., for the Mexican case, among others.

19/ Cuba is, of course, a different case which space limitations make it impossible to discuss here. In this country apparently societal factors, such as full male employment, social security and access to free public health



services for all the population, compulsory primary education and age restrictions on employment, have led to a smaller family-size norm, while the provision of abortion and fertility regulation services by the Government has provided the means to adjust actual to desired family size.

20/ Food and Agriculture Organization of the United Nations, op.cit.

21/ Ibid.

22/ Latin American Demographic Centre (CELADE), Boletín Demográfico, No. 28, 1981.

23/ Economic Commission for Latin America, Long-term Trends and Projections of Latin American Economic Development (E/CEPAL/1027), 3 March 1977.

24/ V. Faria, "O sistema urbano brasileiro: resumo das características e tendências recentes", Estudos CEBRAP, No. 18 (1976); R. Urzúa, et.al., Desarrollo Regional, Migraciones y Concentración Urbana en América Latina, PISPAL-CELADE, mimeo, 1982.

25/ For a more detailed discussion of these and other environmental and social consequences of the style of development on the internal characteristics of the metropolitan areas, see O. Sunkel, La Dimensión Ambiental en los Estilos de Desarrollo de América Latina (E/CEPAL/G.1143), July 1981, pp. 72-80.

26/ For a study examining the relationship between the rates of urban growth and urban deterioration, see Ligia Herrera, La Concentración Urbana y la Dispersión de la Población Rural: Su Incidencia en el Deterioro del Medio Humano, Santiago, Chile, Latin America Demographic Centre (CELADE), Series A, No. 126, 1976.

27/ For a discussion of the empirical evidence on this point, see R. Urzúa, Social Science Research on Population and Development in Latin America, Mexico City, International Review Group, appendix 11, December 1978, pp. 104-111.

28/ O. Sunkel, op.cit., pp. 78-79.

29/ See Economic Commission for Latin America, Report of the Regional Seminar on Metropolitanization and Environment, "General conclusions", Curitiba, 16-19 November 1981 (E/CEPAL/L.266), 5 May 1982.

30/ See footnote 1.

31/ Emiliano Ortega, La experiencia latinoamericana y el desafío campesino (E/CEPAL/PROY.6/R.45), 16 March 1982.

32/ Emilio Klein, op.cit., Table 1, p. 17.



33/ Junta Nacional do Algodao (JUNAL), "Programa Andino de desarrollo tecnológico para el medio rural, resumen", (J/G.T./99), Lima, 1981, quoted in Ortega, op.cit., p. 16.

34/ Emilio Klein, op.cit., table 2.

35/ División Agrícola Conjunta CEPAL/FAO, Bolivia: El Desarrollo Agrícola de Post-Reforma, October 1980.

36/ Ibid., p. 21.

37/ División Agrícola Conjunta CEPAL/FAO, La Agricultura y las Relaciones Intersectoriales: El caso de Bolivia (E/CEPAL/R.205), September 1979.

38/ Economic Commission for Latin America/Food and Agriculture Organization of the United Nations, Bolivia, table 14, p. 48.

39/ G. González, Procesos Demográficos y Economía Campesina, table 5, p. 24.

40/ H. Behm and D. Primante, op.cit., table 5.

41/ National Fertility Survey, Peru, 1977-1978, as quoted by H. Ramos, Mortalidad Infantil y Atención Materno Infantil en el Perú, Latin American Demographic Centre (CELADE), March 1981.

42/ M. Posso, Estratos sociales y fecundidad en Ecuador, Latin American Demographic Centre (CELADE), 1982 (mimeo).

43/ G. González, op.cit.

44/ Luis López Cordovez, "Trends and recent changes in the Latin American food and agricultural situation", CEPAL Review, No. 16 (April 1982), p. 15.

45/ Food and Agriculture Organization of the United Nations, op.cit.

46/ G. González, Procesos Demográficos y Economía Campesina: El caso Boliviano, paper submitted to the ECLA/UNEP Regional Seminar on Agrarian Policies and Peasant Survival in High Altitude Ecosystems, Quito, Ecuador, 23-26 March 1982.

47/ República de Bolivia, Ministerio de Planeamiento y Coordinación, Programa de Políticas de Población, Modelo LRPM 2, and G. González, op.cit., p. 63, et seq.

48/ George Martine, Expansao Retraçao de Emprego no Fronteira Agricola, (E/CEPAL/PROY.6/R.24), 28 October 1981.

49/ G. Martine, op.cit., table 12.

50/ G. Martine, op.cit.; Philippe Lena, Expansao da Frontera Agricola em Rondonia, Ocupação do Espaço e Dinamica da Estrutura Agraria, (E/CEPAL/PROY.6/R.25).



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52/ T. Merrick, "Fertility and land availability in rural Brazil", Demography, 15, 3, 1978.

53/ G. González, 1982.

54/ J.A.M. Carvalho, "Evolução Demografica Recente no Brasil", Pesquisa e Planejamento Económico, vol. X, No. 2, 1980.

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#### D. Population growth, inequality and poverty

Gerry Rodgers\*

##### Some issues

Population growth is widely considered a hindrance to economic development. Rapidly increasing populations are thought to restrict the spread of social infrastructure, to reduce the growth of income per person, to aggravate pressure on limited national resources, to lead to excess labour supply and unemployment. Among the items on this list, income distribution figures prominently: rapid population growth is considered to be one factor leading to inequality in the distribution of income.<sup>1/</sup> Given the expectations for adverse effects on economic growth, it follows that population growth will worsen most aspects of poverty, both relative and absolute.

Why would rapid population growth increase inequality? Many reasons have been suggested, such as the following:

(a) Population growth increases the supply of labour relative to land, which is fixed, and to capital, the growth of which is considered to be independent of or negatively related to population growth. This will tend to reduce the average remuneration of labour relative to land and capital, and indeed the aggregate remuneration of labour as well if labour cannot be readily substituted for other factors of production.

(b) Population growth tends to promote inequality of land ownership; the division of holdings leads to unviable farms in the smallest land groups where land would eventually be lost through mortgage or distress sales, leading to an increase in the proportion of the landless population.

(c) Population growth is often found to be more rapid among lower income groups. If the share of these groups in national income is fixed, and there is little mobility, the relative incomes of the poor will decline.

(d) The welfare of the poor is often held to be dependent on government interventions - schooling and medical facilities, nutrition programmes, employment generating schemes and so on - of which the cost rises almost in proportion to the population covered. Thus population growth either raises the total cost of these programmes, or reduces the fraction of the population they can reach.

(e) High fertility and dependency limit the capacity of parents to save, or to invest in the education or health of their children. This constraint is felt much more severely among the poor, leading to inequality in "human capital" - and hence in income - in the next generation.

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\* International Labour Organisation.



Other such relationships can also be found. They make a strong *prima facie* case for the adverse effects of population growth on inequality. Later on in this paper some of the assumptions that are built into these relations will be looked at critically. But for the present the main point to note is that these are expectations and hypotheses, rather than empirically verified relationships. The frequent repetition of these hypotheses, without empirical support, often leads to their uncritical acceptance. It is therefore doubly important to look at the empirical issues.

The testing of propositions about the effects of population growth on inequality runs into several problems. First, all of the relationships noted above are subject to considerable lags. Although there may, in theory, be significant effects of a 2 to 3 per cent population growth in one year, in practice only the cumulation of 5 or 10 years' growth is likely to give rise to statistically observable outcomes. What is more, one of the suggested effects is essentially intergenerational; one depends on the growth of the labour force (which follows population growth with a roughly 15-year lag); and a third depends on household formation, which is responsive even more slowly. We therefore need a very long-time horizon. But in most countries, especially developing countries, the last 20 or 30 years have been periods of substantial political and economic change, the effects of which are not easy to separate from those of population growth.

Second, measures of inequality are essentially aggregative. We cannot easily test our propositions using household data, and measures of inequality at the community level are difficult to compile. This makes empirical work primarily dependent on measures of national inequality, which have to be analysed either in time series or in cross-section. In both cases, there are serious problems. Usable time series of inequality are rare, and their analysis is plagued by the variety of lags in the relationship with population growth. International cross-section analysis faces problems of non-comparability, especially in measures of inequality, while structural and cultural differences between countries make firm conclusions difficult to reach.

Finally, the relationship between population growth and income distribution involves a number of different components. The most serious complication arises because there is reason to expect income distribution to affect population growth, as well as vice versa; we discuss some of the detail of this interaction below. On the whole, the lags in the effect of inequality on population growth are likely to be shorter than those in the reverse relationship, so that a stylized model might see current inequality affecting current population growth, which in turn affects future inequality. The problem here is that current and future inequality will be closely related, if only because inequality is partly the result of an additional, perhaps unchanging set of structural factors, the effects of which are not always easy to isolate.

The remainder of this chapter takes up some of these issues. First, the type of relationships that can be observed in inter-country comparisons are explored, with a discussion of the results achieved by several other authors, and presenting some new estimates using an International Labour Organisation



(ILO) data bank. Second, some basic conceptual problems are raised which confront work in this field. And finally, some of the theoretical and empirical issues are re-examined which are relevant to work at the national level.

The focus on population growth has led to a neglect of migration in what follows. A good case can be made that migration is more important for poverty and inequality than population growth per se; the issue has been left aside here because it has been treated in some detail elsewhere.2/

### Inter-country analysis

Inter-country comparisons, despite their weaknesses, appear to be the easiest starting point for empirical analysis, and several authors interested in the topic of this paper have already used international cross-section data. These include: M. Ahluwalia, R. Repetto, D. Morawetz, H. Ogawa, A. Flegg, G. Rodgers, R. Moreland and C. Winegarden.3/ Some of their principal results are summarized in table 1.4/ Where fertility is the dependent variable, all authors except Winegarden find a strong positive relation with inequality. Winegarden finds a strong negative relation, a result which can be mainly traced to the fact that he controls for family planning efforts.5/ But it turns out that where family planning is endogenous, as in Ogawa's model, it is strongly negatively associated with inequality, so that the positive relationship between fertility and inequality would probably re-emerge if family planning were also endogenous in Winegarden's model. Where inequality is the dependent variable, all authors find that it is positively, usually strongly affected by fertility or population growth. Other relationships fluctuate to some extent with the sample and the specification (especially relationships with income), but the effect of mortality on fertility is consistently positive, and that of literacy consistently negative.

These results have their critics. For instance, Bryan Boulier considers that the international data base is inadequate for statistical analysis: "It is doubtful whether the income distribution data are sufficiently comparable among countries to support the econometric analysis for which they are used". He also argues that the models are inadequately specified: "It is most unclear whether the statistical association between the distribution of income and fertility among nations is a causal association or merely a spurious correlation due to underlying (unmeasured) social and economic factors jointly determining fertility and the distribution of income".6/ Of course, it is a time-honoured practice to attack the data if one is unhappy with the results, or to postulate additional unobservable relations which would undermine those estimated. While there is merit in Boulier's remarks, pending the development of better data and improved models we must accept the use of international cross-section results as one element in the array of evidence.

Most of the authors cited above were mainly interested in establishing current interactions between fertility or mortality and inequality (Winegarden (in press), also considers lagged relationships). For the present study, a more interesting question appeared to be to establish interactions between



Table 1. International cross-section analyses of the relationships between population growth and income distribution

(a) Dependent variable: fertility

Author	Morawetz, 1978	Flegg, 1979	Repetto, 1978	Winegarden (in press)	Ogawa, 1978
Dependent variable	General fertility rate (approx)	General fertility rate (approx)	Gross reprod. rate/general fertility rate	General fertility rate (approx)	Crude birth rate <u>a/</u>
Relationship with inequality <u>b/</u>	++	++	++	--	++
Measure of inequality	% share of bottom 40%	Atkinson's index	Gini coefficient	% share of bottom 40%	Gini coefficient
Relationship with income	-	--	-	++	--
Relationship with first difference of income	n.a.c./	n.a.c./	n.a.c./	n.a.c./	++
Relationship with mortality	+	+	+	non-linear; ++ in relevant range	n.a.c./
Relationship with literacy	-	--	--	(school enrolment)	n.a.c./
Other independent variables	none	none	none	labour force in agriculture, family planning effort	fam. planning "setting", female labour participation
Other endogenous variables	none	female labour force participation	inequality, infant mortality	inequality, life expectancy	inequality, family planning
No. of countries	up to 80	60	45	31	20

Note:

Relationships: 0: none or very weak; +, -: weak or moderate; ++, --: strong.

a/ Indirect effects via a family planning function.

b/ Positive sign: more inequality.



Table 1. (continued)

(b) Dependent variable: inequality a/

Author	Repetto, 1978	Winegarden (in press)	Ogawa, 1978	Ahluwalia, 1976
Dependent variable	Gini coefficient	% share of bottom 40%	Gini coefficient	Percentile shares
Relationship with fertility	+	n.a. b/	++	n.a. b/
Relationship with pop. growth	n.a. b/	++	n.a. b/	++
Relationship with income	0	+	++	++
Relationship with first difference of income	n.a. b/	n.a. b/	-	--
Relationship with income growth	n.a. b/	--	+	n.a. b/
Relationship with literacy	n.a. b/	- (school enrolment)	0	--
Other independent variables	education dispersion, land inequality	agriculture %, public sector investment	none	% agricult- ure urbanization "socialist"
Other endogenous variables	fertility, infant mortality	fertility, life expectancy	fertility, family planning	none
No. of countries	45	31	20	60

Note:

Relationships: 0: none or very weak; +, -: weak or moderate; ++, --: strong.

a/ Positive sign: more inequality.

b/ n.a.: not applicable, this variable not included.



income distribution and population growth over time, so that a careful specification of lagged relationships was needed. There also seemed to be a strong case for incorporating overall income growth endogenously into such a model, given that this is widely believed to have close relationships with both income distribution and population growth. The remainder of this section is devoted to presenting, in summary form, the results of a new international cross-section analysis set up in these terms.<sup>7/</sup> The data used came mainly from a file established at ILO by M. Hopkins, for the analysis of basic needs satisfaction. Details of this file are reported in R. Rietschin.<sup>8/</sup> Results from another analysis using this file were reported in Sheehan and Hopkins.<sup>9/</sup> Some information was also added to the file from World Bank sources.

The first point to establish is the existence, in these data, of the negative relationship between equality of income distribution and population growth reported by other authors. Simple correlations for different measures and different time periods indicate that the relation is indeed present:

- (a) Percentage of income received by the poorest 40 per cent of households in 1970 and population growth in the period 1960-1970 -  $R = -.44$ ;
- (b) Percentage of income received by the poorest 40 per cent in 1970 and population growth in the period 1970-1977 -  $R = -.42$ ;
- (c) Percentage of income received by the poorest 20 per cent in 1970 and population growth in the period 1970-1977 -  $R = -.24$ ;
- (d) Percentage of income received by the the poorest 40 per cent in 1960 and population growth in the period 1960-1970 -  $R = -.32$ .

The next stage is to build a model in which both population growth and inequality are endogenous; as argued above, output growth should also be endogenous in such a model. First, consideration is given the interactions between these three variables. Inequality can reasonably be considered to be affected by past population growth and past income growth, in both cases a higher rate of growth tending to generate an unequal distribution. A distributed lag function would be ideal, but the data here will not support this; the assumption is that current inequality is affected by the previous decade's growth of income and of population.

Population growth seems more likely to be affected by income levels than by income growth. The components of population growth, i.e., fertility, mortality and migration, are all commonly thought to be associated with income levels. A relationship is also postulated here with income distribution, either current or with fairly short lags. This has been modelled by assuming that population growth during a given period depends on income levels and income distribution at the start of the period (the income levels in turn depending on income growth in previous periods).

Income growth, during a given period, may be associated with inequality at the start of the period for many reasons - e.g., because inequality may affect savings and thus investment. It is also likely to be associated with income levels at the start of the period, in that a catching up process via the



diffusion of existing technology should make growth easier at low incomes, other things being equal. The link with population growth involves both current and lagged components. Current population growth, consisting essentially of children, will increase the number of consumers and thus reduce income per capita directly (although there may be offsetting effects, e.g., through changes in the work of adults). Past population growth, however, will be associated with increases in the current labour force, and thus with higher output growth, and there may also be lagged adaptive technological changes à la Boserup which affect output growth.<sup>10/</sup>

In summary, the interactions between the endogenous variables can be portrayed as follows, where P = population; GP = population growth rate; X = output or income per capita; GX = output or income per capita growth rate; Q = income inequality; and t = time.

1.  $Q(t) = f_1 GP(t-1, t), GX(t-1, t)$
2.  $GP(t+1, t) = f_2 X(t), Q(t)$
3.  $GX(t+1, t) = f_3 X(t), Q(t), GP(t+1, t), GP(t, t-1), GP(t-1, t-2),$

To this system is added the identity,

4.  $X(t) = X(t-1)(1 + GX(t, t-1))$

It should be noted that this system is entirely recursive. This has implications for estimation and distinguishes the model from many of its precursors in the literature, which have been concerned with the estimation of simultaneous systems.<sup>11/</sup>

The next step is to specify the form for the dependent variables, and the set of exogenous variables to include in estimable formulations of models for Q, GP and GX. This process is summarized briefly below.

For inequality the income share of the bottom 40 per cent of households was used, around 1970 as far as possible.<sup>12/</sup> Following Ahluwalia, this was made a non-linear function of GNP per capita; Ahluwalia was also followed in using a separate dummy variable for the socialist countries of Eastern Europe, and a variable measuring literacy.<sup>13/</sup> For population growth and GNP per capita growth, total growth over 1960 to 1970 was used. The equation retained is reported in the first column of table 2. Note the relatively poor performance of the population growth variable, in interesting contrast with the correlations reported above. It was not at all improved by substituting growth over the period 1950-1970, nor did introducing a separate population density measure help.

Population growth may be itself used as a dependent variable; alternatively, one may use the components of population growth - births, deaths and migration - as dependent variables and compute population growth on the basis of these elements. But at the level of international cross-section, most of the explanatory variables for these three components will be similar, so that not much is lost by aggregating them; the simplification seems



Table 2. Estimated relationships (t statistics in brackets)

Independent variables	Dependent variables		
	% of income received by bottom 40%, around 1970	Population growth 1970-1977 (% per annum)	Growth in GNP/capita 1970-1977 (per annum)
Log GNP/capita, 1970 (\$)	-20.7 (5.43)	2.44 (2.43)	-
Log GNP/capita squared, 1970 (\$)	1.49 (4.92)	-0.193 (2.51)	-
GNP/capita, 1970 (\$)	-	-	-0.000125 (2.62)
% of income to bottom 40%, 1970	-	-0.048 (1.67)	0.00125 (0.02)
Growth in GNP/capita, 1960-70	0.539 (2.97)	-	-
Population growth 1970-77 (% p.a.)	-	-	11.850 (1.91)
Population growth 1960-70 (% p.a.)	-0.790 (1.35)	-	-
Population growth 1950-60 (% p.a.)	-	-	0.716 (1.84)
Literacy, 1970 (%)	0.059 (3.19)	-0.011 (2.19)	0.0119 (0.86)
% of workers in agriculture, 1970	-	0.018 (2.52)	-
Socialist, 1970	7.81 (4.95)	-0.722 (1.68)	-
Eastern Europe	-	-	0.281 (3.13)
Military expenditure as % of GNP, 1970	-	-	4.01 (4.94)
Log investment as % of GNP	78.6 (7.06)	-4.71 (1.41)	111.5 (3.97)
Intercept	0.62 72	0.72 67	0.53 63
R <sup>2</sup>			
N			



acceptable for the purposes of this paper, though in a more detailed model there would probably be some returns to breaking down population growth. Population growth was thus used over the period 1970-1977 as the dependent variable. The formulation for the explanatory variables was similar to that for the inequality function, except that the proportion of the population working in agriculture was added.<sup>14/</sup> Results are given in the second column of the table. The inequality measure is statistically weakest among the explanatory variables. This appears at first sight to contradict the strong relationships found by Repetto and others between inequality and fertility, but the reason is quite simple. Greater inequality appears to be associated not only with higher fertility, but also with higher mortality; it is therefore not surprising if the net impact on population growth is fairly weak.<sup>15/</sup>

For the third endogenous variable, growth in GNP per capita over the period 1970-1977 was taken. A similar set of explanatory variables was used, with the addition of a measure of investment and of military expenditure. The formulation for population growth allowed for both current and lagged effects; both had the expected sign, and were statistically significant at the 10 per cent level.

Some general comments about results of this type are in order. First, the data base is of uneven quality and often not strictly comparable across countries. Second, the statistical problems, notably multicollinearity, make the models very vulnerable to slight changes in specification. Third, the range of variables for which data are available is limited. As another practitioner of the international cross-section art commented, "an information base of such modest quality undeniably warrants modest conclusions".<sup>16/</sup> But given the absence of good alternative ways to test our hypotheses, it is quite legitimate to look for clues even in a weak data base. And certain conclusions, while indeed modest, may be drawn from these results. To approach such conclusions, it is necessary to assess the overall picture that these three equations provide. It is possible to solve the estimated system of equations, but a more graphic way of presenting results is to simulate the evolution of key variables over time. This of course is based on the assumption that inter-country differences give a guide to the development paths followed by individual countries.

A very simple aggregate model was therefore constructed, using the three key behavioural equations as a core. Four other variables were also incorporated endogenously: investment, literacy, the labour force share in agriculture, and the proportion of children in the population (used in computations of incomes per adult equivalent).<sup>17/</sup> Details of the specification and estimation of these functions are given by Rodgers.<sup>18/</sup>

The model was run for 10 year intervals from 1970 to 2050. It was necessary to select a starting point for 1970; taken as an example here is a country with GNP per adult equivalent of around \$ 120 in 1970 and literacy at just over 20 per cent; GNP is growing initially at just under 5 per cent a year. These figures would broadly correspond to a relatively poor Asian country, or to a middle-income African country, in 1970.



Three different simulations are reported in figures I to IV. First, a "reference" simulation, which represents an "average" development pattern; second, a "population" simulation, in which the annual population growth rate is reduced by 1 percentage point; and third, an "equality" simulation, in which the share in income of the bottom 40 per cent of households is raised by 5 percentage points. These are substantial changes, implying major shifts in policy or in behaviour.

Each figure shows the evolution of one variable over time under the three different model assumptions. Figure I shows GNP per adult equivalent, an approximate indicator of mean income, on a log scale (equal distances between points on this scale imply equal percentages, not absolute differences). The outcomes are surprisingly insensitive to the quite substantial experimental changes involved; in 2050, after 80 years, the highest simulation (population) is only 21 per cent ahead of the lowest (equality). The pattern over time is also contrary to conventional expectations. Where population growth is reduced, significant income gains are built up at first (compared with the reference run), peaking at a 16 per cent gain in 1990; but thereafter the gain is steadily whittled away, and by the end of the simulation period it is down to 7 per cent. This is quite contrary to the conventional view of gains from reduced population growth, which are thought to build up slowly but eventually to become substantial. Our result is due to the longer-term positive feedbacks from population growth to GDP growth, and (to a lesser extent) changes in investment and literacy. The simulation with reduced inequality differs little from the reference for the first 40 years. Thereafter, it starts to fall behind the reference run. This relative decline can be largely traced to a negative effect of the income share of the poor on investment (which, however, was statistically weak, and so should be interpreted with caution).

Figure II gives the percentage share in income received by the poorest 40 per cent of households. In all three runs there is a decline in the share, concentrated in the period 1980 to 2030, after which date the bottom of the Kuznets U-curve seems to be reached. The relatively more equal results with the reduced inequality run merely reflect the 5 per cent experimental change, but the pattern with the population run is interesting. At first, reducing population growth reduces inequality (raises the share of the poorest 40 per cent), because of the direct effect of population growth in the equality function. But the longer-term indirect relationships have the opposite effect, operating through the effects on GNP per capita (figure I) and literacy. Eventually, the population run stabilizes with the income share of the poorest 40 per cent about half a percentage point below the reference run - not much, but opposite in sign to the expectations of those who see high population growth as a major cause of inequality.

If figure II suggests that reducing population growth is unlikely to reduce inequality, figure III gives some indication that reducing inequality may reduce population growth. In all three runs shown in Figure III, population growth declines quite sharply after the year 2000. The reduction in inequality generates a decline in population growth of about 0.2 percentage point, relative to the reference run.



Figure I. Gross national product per adult equivalent

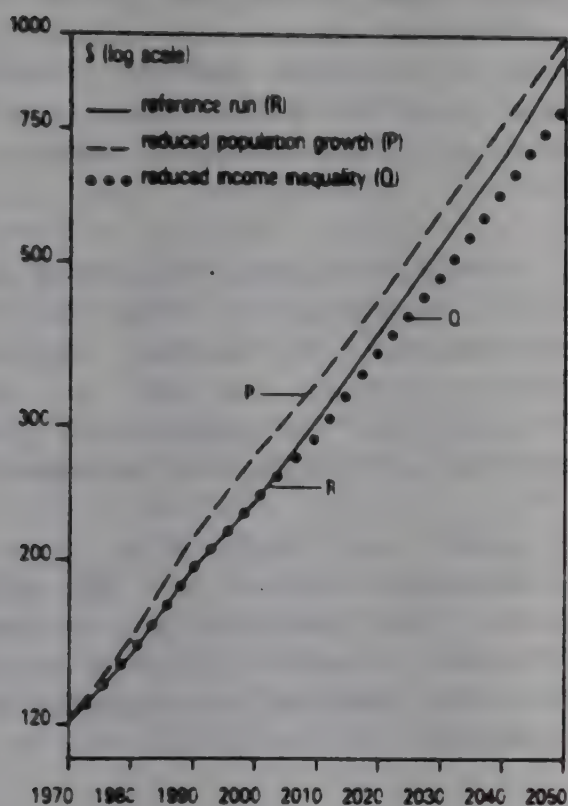


Figure II. Percentage of income received by bottom 40% of households

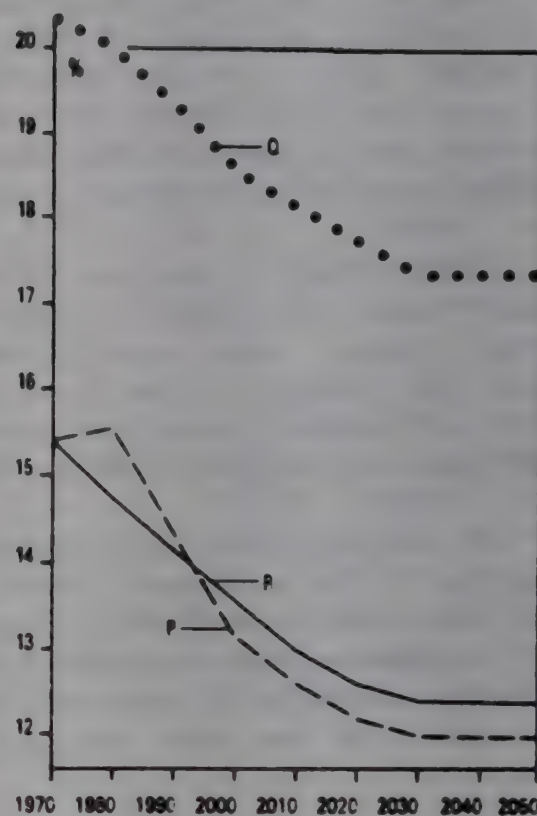


Figure III. Population growth (percentage per year)

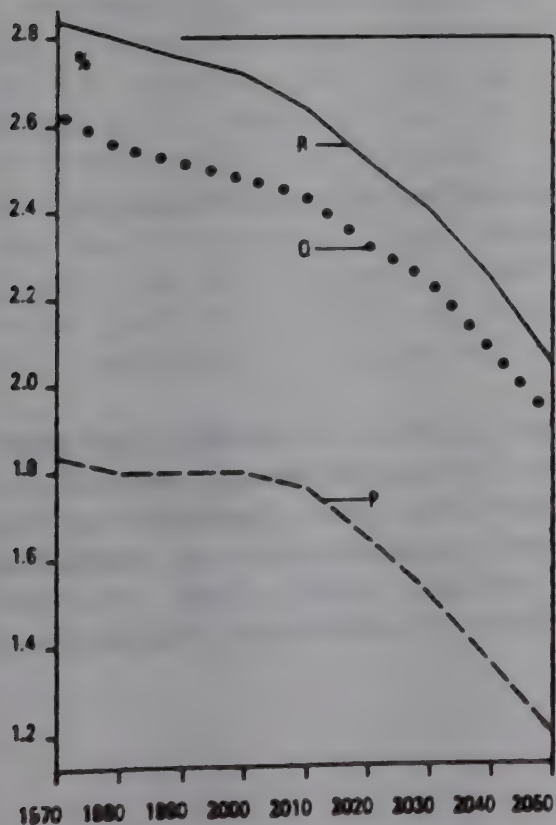


Figure IV. Income per adult equivalent among bottom 40% of households

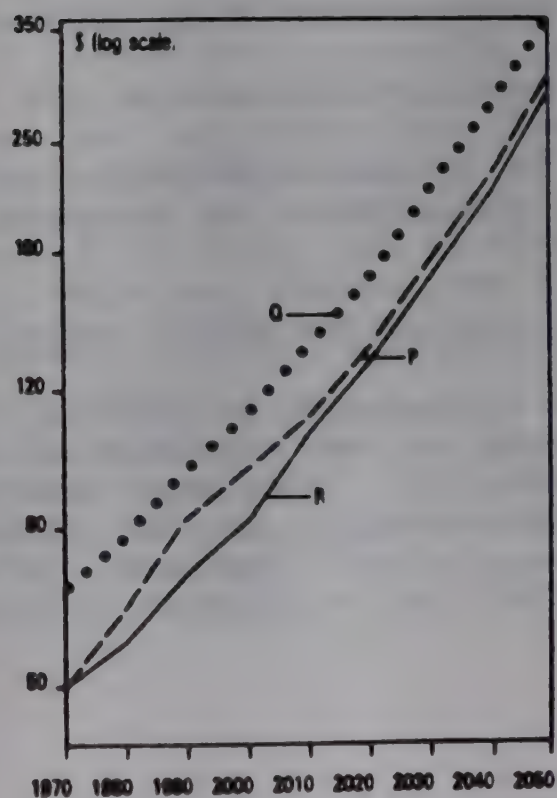




Figure IV combines the information from figures I and IV to give an indicator of incomes among the poor. Despite worsening income distribution, the incomes of the poor rise steadily in all three runs. The impact of reduced population growth parallels that found in figure I, but is somewhat more extreme; the maximum gain due to reduced population growth is about 18 per cent in 1990, but drops away more rapidly than in figure I, and is down to 3 per cent at the end of the simulation. The run where inequality is reduced generates gains for the poor throughout the simulation period, peaking at 36 per cent in 1990, then declining to 23 per cent in 2050. Thus in figure IV the reduced inequality run does consistently and substantially better than the reduced population growth run.

These results suggest that, contrary to expectations, reducing population growth does not seem to generate long-term benefits for the poor in this model, though some short-term gains are found. Increasing equality does appear to generate some decline in population growth, as well as persistent gains in incomes among the poor, but the reductions in population growth look small when set against the substantial reduction in inequality assumed.

To sum up, the specification of this model, and especially the data base on which it is estimated, can no doubt be improved upon. But the expectation that population growth will increase inequality and poverty is so dominant in the literature that one would expect this result nevertheless to come through strongly; after all, many of the other results conform to expectations. The fact that this one does not gives cause to ponder.

#### Some conceptual problems

Before pursuing the empirical issues further, it will be helpful to pause in order to address some conceptual and methodological questions that have been side-stepped so far. The central problem is that inequality and poverty are not the simple variables that the previous section assumes; they are complex both conceptually and empirically. Three major sets of issues are particularly relevant:

- (a) The nature of the unit of analysis;
- (b) the reference time period;
- (c) the conceptualization and measurement of welfare in relation to inequality and demographic change.

#### The nature of the unit of analysis

The majority of official statistics on income, consumption and related measures use the household as a unit of analysis, although definitions vary considerably. Also much analysis of fertility uses models of household decision-making. But the number, size and composition of households are systematically associated both with income and with fertility.<sup>19/</sup> T.P. Schultz, for instance, decomposes household income per capita in Colombia



by the number of adults and of children.<sup>20/</sup> He identifies a positive relation between the number of adults and household income per capita, and a negative relation between number of children and household income per capita. So households with higher fertility experience will in general report lower incomes per capita. Thus the distribution of fertility across the population is directly reflected in income inequality per capita. Note that Schultz uses per capita household income. But most official statistics, especially for income distribution, use per household incomes (and this is what was used in the international cross-section analysis). Larger households tend to report higher total incomes, again generating an automatic relationship between inequality and demographic change. The way in which this affects the relationships between population growth and inequality will depend on how fertility and mortality changes are distributed across the population, and also on the time lags between changes in population growth and changes in age composition. But there will in general be an effect.

In fact, the problem is even wider than this, for the most relevant concept of inequality might involve individuals, nuclear families, households, broader kin groups such as the Chinese chia, or entire communities or classes.<sup>21/</sup> For example, a fall in population growth arising from a fall in fertility may be directly associated with changes in the relative status of women, thus modifying sexual inequality even if household income inequality remains unchanged. At a different level, inequality between communities may be unaffected by fertility and mortality changes which have a significant impact on the distribution of household income.

#### The reference time period

A second issue, in some ways related to the first, concerns the time period over which income is measured. The shorter the time period, in general, the more unequal the measured distribution of income. The distribution of income over a period of years, or over a lifetime, will usually be less unequal than the distribution of, say, last year's income. So a part of measured inequality can be traced to income changes over the life cycle, because in many (but not all) occupations, there is a rise in income with age and experience. Population growth affects this aspect of inequality because it affects the age distribution of populations; a rapidly growing population will have a larger fraction of its members concentrated in the younger lower-paid age groups. Schultz shows that age composition alone can account for a substantial fraction of measured inequality, although he finds that age is distinctly less important for inequality in Colombia than in the Netherlands or the United States of America.<sup>22/</sup> M. Paglin and R. Wada show that such factors contribute significantly to explaining changes over time in measured inequality in Japan and the United States, respectively.<sup>23/</sup>

Another, often overlooked point about the time horizon is that in most societies average incomes are rising; thus future generations can expect to have higher incomes, on average, than the present generation. If a reduction in population growth eventually increases income (not an obvious outcome, by the way - see the results in the last section), it may increase intergenerational inequality. Whether this point is important will depend on



whether there are significant costs to be borne by current generations - but the issue cannot be ignored given the long-term nature of demographic processes.

The conceptualization and measurement of welfare  
in relation to inequality and demographic change

The concern with poverty and inequality implies a concern with welfare, not just with income. This has several consequences. One is that we need to widen the definition of income to encompass measures of "non-market income", including valuation of leisure, or more important for poverty analysis, measures of access to education, health and other public goods. There is evidence that, for instance, educational enrolment is lower in large families.<sup>24/</sup> Growing populations put exceptionally heavy demands on educational and some aspects of health infrastructure, and it is quite possible that inequality in access to these services arises as a result. There may in particular be differential access to goods and services by birth order - higher order children are relatively disadvantaged, generating a distinct link between high fertility and inequality.

A second aspect, which also has far-reaching consequences for interactions between inequality and demographic change, is to consider the direct implication for welfare of mortality decline; Kuznets brings this out clearly.<sup>25/</sup> A fall in mortality without a corresponding fall in fertility reduces per capita income if nothing else changes, but it is unambiguously an increase in welfare. How this affects measured inequality depends on the distribution of mortality declines. Recent mortality declines have probably been concentrated in the lower to middle income ranges of most populations, thus increasing per capita income inequality while reducing welfare inequality.

A third, and equally fundamental aspect, is to consider the value to parents of children themselves. Psychic issues are discussed by R. Blandy <sup>26/</sup>, while practical examples of the economic rationality of high fertility are provided by M. Mamdani.<sup>27/</sup> Measured welfare should somehow take into account the value, to parents, of their children; wanted children therefore enter into the numerator of the measure of welfare, as well as into the denominator. "Unwanted" children, if somehow their numbers could be measured, might plausibly be regarded as only belonging in the denominator. On the other hand, it is not obvious that high fertility is in the interests of the children themselves, as opposed to their parents, at least beyond a certain, difficult to identify, family size. The complications for analysis of inequality in the face of changing mortality and fertility are apparent.

The main conclusion to draw from these conceptual and methodological issues is that the problem is distinctly more complex than might appear at first sight. Indeed, many of the more important points - e.g., the last one - are not amenable to empirical treatment. In interpreting empirical findings, it is necessary to be aware of these different aspects of inequality and the correspondingly varied links with demographic change.



### Return to structures and processes?

If international comparisons give us largely negative results, and if we wish to face up to the methodological issues outlined above, then we must return to the structures and processes at work within countries to see whether they permit us to advance further. The issues raised by the effects of inequality on population growth are quite distinct from those involved in the generation of inequality, and are treated separately below.

### The effects of inequality on population growth

This paper will not devote much attention to the influence of inequality on population growth, an issue that has been abundantly discussed elsewhere *inter alia*, see G. Farooq and O. Simmons.<sup>28/</sup> We may note, with R. Repetto<sup>29/</sup>, that most researchers who have explored non-linearities in the effects of income on fertility have found them; whence it follows that the pattern of inequality will also affect fertility and hence population growth.<sup>30/</sup> Indeed, many of the variables commonly found to be related to fertility - education, female labour supply, land ownership, child work and so on - are closely bound up with patterns of social inequality, so that in consequence the pattern of inequality indisputably affects fertility. Experiments with a "basic needs" strategy, using an economic-demographic model of the Philippines with population growth endogenous<sup>31/</sup>, indicated that broad, welfare-oriented policies can have substantial effects on fertility and - to a lesser extent, because there are also changes in mortality - on population growth. The size of this effect is more disputable, and although the bulk of the evidence suggests that less inequality is associated with lower fertility, counter-examples have been reported, so that a case-by-case approach to analysis is required.

Less attention has been paid to more aggregative, structural relations between inequality and population growth. Is there any reason to suppose that inequality *per se* affects fertility and thus population growth, as opposed to the indirect effects due to the societal distribution of variables that enter into micro-level fertility functions? Evidence on this is hard to come by, although there must be some expectation that the answer will be yes. The distribution of access to jobs and to productive assets will presumably modify perceptions of the benefits of high fertility. Exactly how will depend on the fertility model appropriate to a given social environment. In some circumstances, those with more assets, and easier job access for their children, will tend to have higher fertility - this is a plausible model if fertility behaviour is predicated on the need for and use of family labour, and one widely reported in the literature; see, for example, G. Djurfeldt and S. Lindberg.<sup>32/</sup> In such cases, a more equal distribution of assets and job access may be expected to raise fertility, not just because of movements along a household fertility function, but because of shifts in community expectations. In contrast, high fertility may be a response to the insecurity of families in an economic system where job access is uncertain; for a description of such a system in South Asia see M. Cain.<sup>33/</sup> A large number of sons may be needed to ensure that one or more shall obtain some source of



income, or shall survive to provide some insurance against catastrophe. Where this model is valid, more equal access to jobs and assets may be expected to lower fertility. But more empirical work is required on these issues.

### The effects of population growth on inequality and poverty

Although some writers give the impression that the reduction of population growth is a major objective in itself, the final objective must clearly be couched in terms of personal and social welfare. It is therefore ultimately more interesting to assess the effects of population growth on inequality and poverty, rather than the reverse. At the same time, it is considerably more difficult.

At the local level, the analytical and empirical problems faced can be well illustrated by reference to D. Penny and M. Singarimbun 34/, who examined relations between population and poverty in Java. These authors are convinced that the growth of population is the key constraint on poverty alleviation in Java, and they may be correct; but they do not prove it, indeed cannot on the basis of their village studies. Rather, every problem is asserted to be due to population growth; landholdings are small, employment is inadequate, output is insufficient, in some cases incomes have fallen; in every case, the pressure of population is the prime culprit. But at the same time, we learn from their data that the technological possibilities in agriculture are far from exhausted, and that labour intensities are much higher on the smallest plots, so that there appears to be scope for further intensification; that compared with another study carried out 40 years before, land productivity is over twice as high and rice production per head appears to be rather similar to the district average 40 years before, despite population growth; and that peasants refuse opportunities to migrate to new areas where their incomes are said to be several times higher. No picture emerges from their study of the structure of economic relations which generates differential incomes for different groups, and yet this is surely fundamental to understanding how the system evolves.

Another author concerned with population growth in Java, C. Geertz 35/ developed a more thoughtful model of involution, a historical process of absorption of population increase into traditional production systems by a steady increase of intensification without reducing per worker output. For Geertz, the system is "treading water" as population increases. As long as such a process continues, the impact of population increase on inequality is likely to be marginal. Geertz thought that the limits of involution in Java were being approached, and that rural labour would become increasingly proletarianized unless rapid industrialization could absorb the growth in the labour force. In either case, the pressure of population may eventually facilitate the evolution of more polarized, capitalist production relations in the place of a decreasingly viable peasantry. But while Geertz's model seems coherent, the empirical support for this last point is weak. Capitalist production relations appear to have first developed in Indonesia in plantations set up under the colonial regime, and subsequently in the process of industrialization. Neither case seems to be empirically linked to population increase, except insofar as population growth made a pool of labour



available - but in low-population density Africa, wage labour for plantations has been forced out of subsistence agriculture by other means. And observers of Java have been forecasting for 50 years or more that the agricultural system cannot absorb more population growth and yet it still has not broken down.

Penny and Singarimbun, and Geertz obviously operate with quite different theoretical frameworks, and these condition their understanding of the effects of population growth. It is worthwhile exploring in a little more detail the implications of alternative models of social processes; after all, while certain direct implications of population growth for inequality have been noted above, the bulk of the impact is surely indirect, and thus depends on the pattern of social relationships responsible for inequality.

Subsistence models. In hunting and gathering communities, or in egalitarian peasant societies, production for subsistence within a family unit is analytically fairly straightforward. Ecological and technological factors apart, relationships between labour input, dependency, production and socially accepted levels of subsistence determine a pattern of behaviour, which may, as in a Chayanovian model, result in life-cycle fluctuations.<sup>36/</sup> The evolution of such societies in the face of population growth, whether by outmigration of excess labour, or by involution, is built around the maintenance of the subsistence level.

But in exploitative feudal or capitalist systems, the subsistence level becomes a key determinant of "surplus" extraction and inequality. The classical, Ricardian model has production levels determined by the equality of marginal product with the subsistence wage, this in turn determining profits and rent because of diminishing returns to land. Wages are maintained at subsistence level by demographic forces. A basic Marxian model of capitalist development uses similar notions, except that a relative surplus population, which provides the "reserve army", is actively promoted by employers, whether by labour-saving innovation or by promotion of the growth of the wage labour force. Social relations of production, which will depend on the division of labour, the nature of jobs, the technological environment and so on will combine with the subsistence wage to determine the overall rate of surplus extraction and thus of inequality. Relationships of this type are of course not confined to wage labour; they can equally apply to various forms of tenancy or share-cropping arrangements, production relations involving exchange labour and so on.

Population growth is relatively unimportant in such systems; paradoxically, at the same time it is crucial as a source of surplus labour. But the degree of inequality is a property of the social relations of production, and population increase thus has only secondary effects on inequality, although it may be fundamental for the growth of the economic system as a whole. This is the basis for much of the Marxian critique of conventional demography; "over-population is not a matter of too many people, but of unequal distribution of resources".<sup>37/</sup>



Neo-classical models. While neo-classical techniques are often extended to cover subsistence wages, the main characteristic of neo-classical models is that wage levels are endogenous. A subsistence model, by treating wages as exogenous, predetermines a major aspect of inequality. Neo-classical models, by contrast, incorporate wage levels and factor shares into a simultaneous determination of all major economic variables. Income distribution thus becomes a consequence of demands for outputs and supplies of inputs, and of the technological characteristics of production processes. Human capital theory extends the model to cover differentials in education and other personal characteristics, investment in which occurs up to the point where returns equal marginal product; optimality can be expected in societies with perfect capital markets and where there is perfect foresight.

It is models of this sort that most clearly predict adverse effects of population growth on equality, for several reasons: the labour force grows relative to the stock of capital and land, and is therefore remunerated less, especially if the elasticity of substitution is low; there is a substitution of children for other forms of investment, leading to slower production growth, and relatively higher returns to capital; there is a substitution of quantity (of children) for quality, which increases the returns to quality and thus promotes wage differentials (for quality read education in most empirical applications).

The essence of the neo-classical world is that it describes a complete system, so that tests of these predicted partial relationships on their own are of rather dubious value. The few attempts to build comprehensive systems models on a neo-classical foundation have not, on the whole, found strong population growth-income distribution links (see, for example, I. Adelman and S. Robinson),<sup>38/</sup> though stronger links between income distribution and migration have been found.

Institutional models. For many analysts, "institutions" form, in Blaug's terminology, part of the "defensive belt" around their core (usually neo-classical) model. Models that fall in this class include those in which certain wage or price differentials are set conventionally - true for many models of urban labour markets in which "modern" sectors are distinguished from "traditional" or "informal" sectors. In such models the wage differential may arise from turnover considerations, from a tendency for paternalist welfare objectives to be accepted by modern sector enterprises, from the indirect effects of international labour markets on wage levels, from minimum wage legislation, from the impact of "ability to pay" or from other factors that affect only the modern sectors. In contrast, entry to informal sectors is usually assumed to be free and wages set by the market or by rural alternatives.

Many other examples could be cited of models that incorporate constraints on behaviour, various differentials, and other exogenous social institutions. These and a variety of other features of labour markets are usually called upon to provide realism in models for which market response and outcome is the basic underlying hypothesis. As a result, the expected effects of population



growth in such models are partly diluted versions of those in the pure neo-classical model; additional relationships with population growth depend on the precise institutions invoked. In the case of the dualistic labour market models, population growth might drive down wages in the informal sector while leaving modern sector wages unchanged, thus increasing inequality; but if the wage differential is fixed, effects on inequality would arise only through changes in the overall wage share, via the usual neo-classical mechanisms.

Structural approaches. A number of models of labour use, production and distribution do not rely primarily on the market. This is characteristic of segmentation and related models, in which the allocation of individuals to jobs, and of incomes to those jobs, is part of a process of social control and not a question of optimal resource allocation. Productivity is a technological and/or social characteristic of jobs, not of the individuals who occupy them. The perspective which follows is very different from that in the neo-classical model. Rigidity rather than fluidity is the rule. The labour market is segmented on the basis of sex, race, education, migrant status or any other usable characteristic. These characteristics are then used to screen individuals for jobs, whether or not the characteristic is relevant to the performance of the job. In so doing the labour force is divided into groups with conflicting interests, permitting relatively high wages to be paid to more powerful groups of workers, without this leading to higher wages for weaker groups. The outcome is a hierarchized and differentiated employment structure, with considerable wage differentials across sectors and groups of workers, and a relatively smaller wage share as a whole. Different underlying models of production and distribution can lead to a labour market theory of this type. For some, segmentation in terms of "primary" and "secondary" sectors, or in terms of "static" or "progressive" jobs derives mainly from the inner logic of production technology; for others, segmentation is a manifestation of the social relations of production under capitalism, and reflects the interests of capitalists in maximizing the share of profits.<sup>39/</sup>

Population growth is of importance in these models mainly insofar as it facilitates control of the labour force. A rapid influx to labour markets of unexperienced and ill-trained youths, for instance, due to high rates of population growth, might facilitate the lowering of wage levels overall; or lower wages might be paid to this group, using age as a basis for segmentation. In the latter case higher population growth will be associated with greater wage inequality; in the former case with lower remunerations for labour relative to other factors. On the other hand, declining fertility might lead to a rapid growth in an unorganized and relatively exploitable female labour force. But as in the case of the subsistence models, population growth is a secondary, facilitating phenomenon - the basic pattern of inequality is shaped by economic forces.

A key element in all these models is the relative rates of growth of different sections of the population. The usual expectation is that the group that grows fastest is likely to be disadvantaged; if this group is relatively poor, inequality will increase. A simple macro-economic model with this assumption and this result was presented by Ahluwalia and Chenery.<sup>40/</sup> In practice, however, neither estimated fertility nor mortality relationships



entirely support this position. It is true that white collar and other upper classes tend generally to have low fertility; but the assetless are also often found to have lower than average fertility (e.g., in Indonesia, Penny and Singarimbun, 1973; in Kenya, Anker and Knowles, 1982; in India, Djurfeldt and Lindberg, 1980; and elsewhere), and a positive relation between landholding and fertility is often reported.<sup>41/</sup> In addition, mortality tends to be higher among the poor, so that population growth may be distinctly lower than average among the poorest groups. In such a situation, population growth may be concentrated among groups who own enough land so that the subdivision of their holdings is not in itself a primary cause of landlessness (although landlessness may at the same time be increasing for other reasons). The effects of population growth on inequality through this relationship are then far from obvious.

The last sentence might be regarded as a fitting summary of this paper. Starting from one or other of the four classes of models outlined above, it is possible to develop general propositions about the impact of population growth on inequality in specific economic and cultural settings. But empirical analysis of such relationships is, as we have seen, difficult, and debate tends to centre on the merits of the assumptions of the underlying model, rather than on directly testing its predictions. Perhaps as a result, there does not seem to be much empirical support, other than from international cross-section analysis, for the position that population growth leads to greater inequality. Clearly there are reasons for expecting such relationships to be present in certain situations. In particular, some of the conceptual and methodological issues raised here identify aspects of inequality which are directly related to demographic change, and which should if possible be separated out for analytical purposes. Age distributions, the distribution of access to population-related public services, the satisfaction to parents from childbearing, unequal risks of mortality, and the other factors discussed will often be relevant for analysis of interactions between population growth and inequality. But apart from these specific topics, interesting though they may be, there does not emerge from the literature, national or international, a convincing demonstration that the effects of population growth on inequality are important. Future research in this area will perhaps be most productive if it concentrates not on direct relationships between population growth and inequality, but on the multiple roles of population growth in the transformation of systems of production. It is surely these transformations that are the key to understanding changes in inequality. These changes can then be traced in part, and indirectly, to population growth. Whether these links are strong, and whether they are positive or negative, are questions that can only be answered in specific economic, social and historical contexts.

#### Notes

<sup>1/</sup> For a statement of this view, see, for example, World Bank (1974), p. 35.



2/ G.B. Rodgers, "Migration and income distribution", mimeographed World Employment Programme research working paper (WEP 2-21/WP.108; restricted) (Geneva, ILO, 1981).

3/ M.S. Ahluwalia, "Inequality, poverty and development", in Journal of Development Economics, vol.3, No.4 (December 1976); R. Repetto, "The interaction of fertility and the size distribution of income", in Journal of Development Studies, vol.14, No.4 (July 1978) and Economic equality and fertility in developing countries, (Baltimore, Maryland, Johns Hopkins, 1979); D. Morawetz, "Basic needs policies and population growth", in World Development, vol.6, Nos. 11 and 12 (November-December 1978); N. Ogawa, "Fertility control and income distribution in developing countries with national family planning programmes", in Pakistan Development Review, vol.XVII, No.4 (winter 1978); A.T. Flegg, "The role of inequality of income in the determination of birth rates", in Population Studies, vol.33, No.3 (1979); G. B. Rodgers, "Income and inequality as determinants of mortality: an international cross-section analysis", in Population Studies, vol.33, No.2 (1979); R. S. Moreland, A Demographic-Economic Model for Developing Countries: Bachue-International, (Geneva, ILO, in press); C.R. Winegarden, "A simultaneous equations model of population growth and income distribution", in Applied Economics, vol.10, No.4 (December 1978); and "Can income redistribution reduce fertility?", in G. Farooq and G. Simmons (eds.), Fertility in Developing Countries: An Economic Perspective on Research and Policy Issues, (Geneva, ILO, in press).

4/ Table 1 does not include mortality functions, which are more straightforward. Most authors report several specifications, so the summary in the table gives the main tendencies from reported results.

5/ The definition of the education variable is also relevant. See G. B. Rodgers, "Population growth, poverty and inequality in an international perspective" mimeographed World Employment Programme research working paper; restricted, (Geneva, ILO, 1982).

6/ B.L. Boulier, "Income redistribution and fertility decline: A skeptical view", in Y. Ben-Porath (ed.), Income distribution and the family, Population and Development Review, supplement to vol.8 (1982), p. 170.

7/ G.B. Rodgers, op.cit., 1982.

8/ R. Rietschin, "Les determinants de la satisfaction des besoins essentiels et leur impact", mimeographed World Employment Programme research working paper; restricted (WEP 2-32/WP.24) (Geneva, ILO, 1981).

9/ G. Sheehan and M. Hopkins, Basic Needs Performance (Geneva, ILO, 1979).

10/ E. Boserup, Population and Technological Change: A Study of Long-Term Trends (Chicago, Illinois, University of Chicago Press, 1981).

11/ This does not imply that the model is free of problems involving correlation of residuals; indeed there is bound to be some auto-correlation. But simultaneous equations techniques are not appropriate to deal with this problem.



12/ A variety of other measures are possible, but this choice was convenient for subsequent analysis of poverty. Some conceptual problems are discussed in the next section.

13/ M.S. Ahluwalia, op.cit.

14/ R. Anker, "An analysis of fertility differentials in developing countries", in Review of Economics and Statistics, vol.LX, No.4 (February 1978).

15/ G.B. Rodgers, op.cit., 1979.

16/ D. Wheeler, "Basic needs fulfilment and economic growth", in Journal of Development Economics, vol.7 (1980).

17/ Adult equivalents are estimated as adults + 0.5 (children). Details of the specification and estimation of the functions of the aggregate model are given in Gerry Rodgers, op.cit., 1982.

18/ G.B. Rodgers, op. cit., 1982.

19/ S. Kuznets, "Demographic aspects of the size distribution of income: an exploratory essay", in Economic Development and Cultural Change, vol.25, No.1 (October 1976) and Some Socio-Demographic Correlates of Income Inequalities: a Case Study of the Philippines (ST/ESA/SER.R/39).

20/ T.P. Schultz, "Age of individuals and family composition and income distribution", in International Union for the Scientific Study of Population; International Population Conference, Manila, 1981, Solicited Papers, vol.3, (Liège, Belgium, 1981).

21/ S. Greenhalgh, "Income units: the ethnographic alternative to standardization", in Y. Ben-Porath (ed.), op.cit.

22/ T.P. Schultz, op.cit.

23/ M. Paglin, "The measurement and trend of inequality: a basic revision", in American Economic Review, vol.65, No.4 (September 1974) and R.O. Wada, "Impact of economic growth on the size distribution of income: the post-war experience of Japan", mimeographed World Employment Programme research working paper (WEP 2-23/WP.37; restricted) (Geneva, ILO, 1975).

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27/ M. Mamdani, The Myth of Population Control: Family, Caste and Class in an Indian Village (New York and London, Monthly Review Press, 1972).

28/ G. Farooq and G. Simmons, op.cit.

29/ R. Repetto, "A Reply", in Y. Ben-Porath (ed.), op.cit.

30/ A similar comment may be made about mortality.

31/ M. Hopkins, G.B. Rodgers and R. Wéry, "Evaluating a basic-needs strategy and population policies: the BACHUE approach", in International Labour Review, vol.114, No.3 (November-December 1976).

32/ G. Djurfeldt and S. Lindberg, "Family planning in a Tamil village", in L. Bondestam and S. Bergström: Poverty and population control, (London, Academic Press, 1980).

33/ M. Cain, "Risk and insurance: Perspectives on fertility and agrarian change in India and Bangladesh", in Population and Development Review, vol.7, No.3 (September 1981).

34/ D.H. Penny and M. Singarimbun, "Population and poverty in rural Java: some economic arithmetic from Sriharjo", Cornell International Agricultural Development Mimeograph 41 (Ithaca, New York, 1973).

35/ C. Geertz, Agricultural Involution: The Processes of Ecological Change in Indonesia (Berkeley, California, University of California Press, 1963).

36/ D. Thorner, B. Kerblay and R.E.F. Smith (eds.), A.V. Chayanov on the Theory of Peasant Economy (Homewood, Illinois, American Economic Association, 1966).

37/ K.L. Michaelson, And the Poor Get Children, (New York, Monthly Review Press, 1981).

38/ I. Adelman and S. Robinson, Income Distribution Policies in Developing Countries (Stanford University Press, 1977).

39/ M. Carnoy, et.al., Can Educational Policy Equalize Income Distribution in Latin America? (Farnborough, England, Saxon House, 1979).

40/ M.S. Ahluwalia and H. Chenery, "A model of distribution and growth", in H. Chenery, et.al., Redistribution with Growth, Oxford University Press, 1974.

41/ D.H. Penny and M. Singarimbun, op.cit.; R. Anker and J.C. Knowles, Fertility determinants in developing countries: A case study of Kenya (Liège, Belgium, Ordina Editions, 1982); and G. Djurfeldt and S. Lindberg, op.cit.







## E. Health, population and development

United Nations\*

### Introduction

The perception of development, as a goal for human communities, has gradually widened in focus during the period under review. The purely economic perception as typically expressed in terms of per capita gross national product is now seen as inadequate as a measure of man's aspirations and achievements. Information about the national aggregate or per capita product reveals nothing about the distribution of this product among the various groups of the population, and might thus conceal a great amount of social injustice. Even more fundamental, however, is the recognition that the level of production and consumption of goods and services is only one aspect of quality of life and it should not take precedence over all other aspects in the debate on what kind of future man should be working towards. Such goals include the promotion of human dignity and welfare and the radical elimination of poverty, which is the greatest obstacle to national and international progress and peace. Many forces have been at work to bring about this change of perception of socio-economic development, but one of the most important has undoubtedly been the increasing importance assigned to health.

Health is not only a desirable goal in itself; it is also a means and, indeed, an indispensable component, if not prerequisite, of social and economic development. The many vital links between health and development are thus seen as interacting phenomena with far-reaching implications. One such implication is the realization that the availability of health services is only one of many contributions to health development, that the improvement of health status of populations requires a wide range of mutually supportive policy measures and cannot be restricted to health policy in the more narrow traditional sense. The attainment of health targets is dependent on appropriately defined economic progress, on social policy measures aimed at greater equity, on education as a promoter of social self-care, on improvement in the physical and sanitary environment, on the availability of adequate food supply, on the implementation of appropriate population policies, and also on political and institutional changes enlisting the active co-operation of the public. Hence the emphasis placed on health development as an integral component of national and international development strategies. The formulation and implementation of appropriate population policies is of particular relevance in this context and will often be of crucial importance for the long-term prospects of national development. It appears that the most important policy interventions for reducing both birth and mortality rates in developing countries would have to include: education of women, changes in the status of women brought about by shifts from traditional to new occupations, improved income opportunities, access to health and family planning care and information, and changes in attitudes towards family formation.

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\* World Health Organization.



The situation appears less rosy than might have been expected a decade ago. Today 800 million people in the developing world live in conditions of abject deprivation, with incomes too low to ensure basic nutrition and with little access to services essential to health and life. At least 450 million people have less food than is necessary for healthy functioning and survival; even more lead a precarious existence on the brink of hunger. Less than one third of the people in developing countries have safe water and adequate sewage disposal. Housing conditions and educational opportunities in urban areas are far from satisfactory. The number of illiterate adults is increasing. About 300 million adults are not gainfully employed. As regards morbidity, there has been a significant increase (e.g., in schistosomiasis) or resurgence (e.g., of malaria) of certain communicable diseases. Little progress can be reported with regard to tuberculosis or sexually transmitted diseases, though the conquest of smallpox was successfully completed. Cardiovascular disease and cancer continue to be the greatest disease problems of the industrialized countries, with many middle-income countries moving into the same situation. Most of these data are approximations because there is a lack of basic information from a large part of the world, but they do suffice to paint a realistic picture of the enormous problems that have to be overcome for a breakthrough in the improvements of health status of the world's population.

At the same time, the cost explosion in health care in a number of industrialized countries has been partly responsible for a re-examination of the relationships between the growing volume of expensive health care - particularly hospital in-patient care - and improved health indices. There is a growing consensus that additional expenditure on health care, at least in the developed countries, is not bringing about a commensurate improvement in health. Furthermore, a pattern of spending which is heavily biased towards technically sophisticated in-patient care is now seen as inappropriate, even in wealthy countries. In low-income countries the issue is still more clear cut.

#### Primary health care

The universal introduction of primary health care implies a substantial increase in the total costs of the health sector even if the per capita cost for those effectively covered will be much less than at present. By way of illustration, it is estimated that the average annual gap between needed and available resources is in the order of \$US 50,000 million (i.e., \$ 12.5 per head times the average population of the developing countries between now and the year 2000). It is not known how much of this can be borne by the countries themselves, but various approaches to estimation leads to residuals of \$ 5,000 million to \$ 15,000 million to be covered by international transfers; this corresponds to 1.5 to 4 times the level of transfers around 1980. Furthermore, roughly 50 US cents per capita per year was available for family planning services in the developing countries, an amount which was thought to approximately need doubling in the 1980s to ensure an appropriate coverage of information and services on family planning. Of this, roughly one third, or some \$ 500 million, were provided through international development assistance, and some \$ 1,000 million by the countries concerned.



In the search for alternative approaches, that of primary health care emerged as the most important means whereby the health sector could improve the health status of the population and thus make an effective contribution to overall socio-economic progress. These principles were eventually incorporated in the more comprehensive statement on primary health care to be found in the Declaration of Alma-Ata prepared in September 1978 at the International Conference on Primary Health Care. In many ways this Conference represented the culmination of the search initiated in 1973 for an "alternative approach" to the basic health services. It also laid the foundation for initiating the goal of "the attainment by all peoples of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life". Subsequently, a series of national, regional and global strategies for action were elaborated and approved by the governing bodies of the World Health Organization (WHO) during 1981/82. The practical application of these principles of primary health care differs significantly between countries and considerable variations can be observed in the speed with which national primary health care programmes are being implemented. Nevertheless, common principles are pursued, particularly the requirements of active community involvement, support to family self-care, intersectoral approaches as part of overall development plans, and the maximum use of local, human and other resources, the use of appropriate technologies, and priority for prevention and health promotive elements, such as education concerning prevailing health problems, nutrition, maternal and child health care, family planning, an adequate supply of water and basic sanitation and immunization, among others.

#### Monitoring progress

In order to be able to monitor the progress towards the global goal of "Health for all" considerable emphasis is now being placed on the evaluation of the development process in general and social progress, including health improvements in particular. Ways of measuring the impact of health action on the improvement of health status are being given increasing priority, along with indicators for health care generated from information for managerial use at all levels of the health care system. An agreement has been reached on a list of 12 health-related indicators for global review of progress, and other lists with more detailed indicators have been agreed to at the regional level. The 12 indicators are the number of countries in which:

(a) Health for all has received endorsement as policy at the highest official level;

(b) Mechanisms for involving people in the implementation of strategies have been formed or strengthened, and are actually functioning;

(c) At least 5 per cent of the gross national product is spent on health;

(d) A reasonable percentage of the national health expenditure is devoted to local health care;

(e) Health resources are equitably distributed;



(f) For developing countries, there are well-defined strategies for health for all, accompanied by explicit resource allocations, whose needs for external resources are receiving sustained support from more affluent countries;

(g) Primary health care is available to the whole population, with at least the following:

- (i) Safe water in the home or within 15 minutes' walking distance, and adequate sanitary facilities in the home or immediate vicinity;
- (ii) Immunization against diphtheria, tetanus, whooping-cough, measles, poliomyelitis and tuberculosis;
- (iii) Local health care, including availability of at least 20 essential drugs, within one hour's walk or travel;
- (iv) Trained personnel for attending pregnancy and childbirth, and caring for children up to at least one year of age;

(h) The nutritional status of children is adequate, in that:

- (i) At least 90 per cent of newborn babies have a birth weight of at least 2,500 grammes;
- (ii) At least 90 per cent of children have a weight for age that corresponds to the reference values given in annex 1 to "Development of Indicators for Monitoring Progress Towards Health for All by the Year 2000",<sup>1/</sup>

(i) The infant mortality rate for all identifiable subgroups is below 50 per 1,000 live births;

(j) Life expectancy at birth is over 60 years;

(k) The adult literacy rate for both men and women exceeds 70 per cent;

(l) The gross national product per head exceeds \$ US 500.

An example of a regional indicator is the proportion of low birth weight babies (i.e., those weighing less than 2,500 grammes). Because low birth weight is the single most important determinant of the chances for healthy survival and development of the newborn, and because the frequency of low birth weight is closely associated with adverse environmental conditions, this indicator reflects one very important linkage between socio-economic conditions and health. However, health-related socio-economic data cover a wide spectrum of information, most of which is collected outside the health sector and often with little or no consultation with the health administration. Their usefulness for the health sector may therefore be limited and many areas of presumed interaction with health remain largely undocumented and unquantified.

There is, however, good reason to expect that during the next decade the collection and reporting of national health indicators will make available a large amount of serial data on health status, on population and on other aspects of socio-economic development from various parts of the world. Such data can be very useful for understanding the complex interrelations between development variables, as already shown by the data from the World Fertility



Survey, and thus for guiding the development policies and interventions towards the most effective mix.

### Health trends

Among all the interactions between health and development, some of the most important ones are those where population growth and change are intermediate variables. For example, the age/sex distribution of a population is largely the result of trends in fertility and mortality in the past, both of these trends - and especially the latter - having been strongly influenced by the health status of the population and the changes occurring in this status. Conversely, the present age/sex distribution is a strong determinant of the actual health status and health care needs of the population because the disease spectrum and the consequent needs for care vary greatly with sex and age. Hence, many developed countries which have experienced low and decreasing rates of fertility and mortality for several decades now have increasingly top-heavy population pyramids, with rapidly growing age groups about 65 years and, particularly, above 80 years, most of whom are women. Combined with the almost total disappearance of infectious diseases once common in childhood, and with the increase of age-specific incidence of some non-communicable diseases, such as cancer and cardiovascular disease, the changing age/sex distribution has brought about very radical changes in the amount and nature of the demand/need for health care. Similar changes are already beginning to be felt in many developing countries, and projections indicate that these will accelerate in the years to come. The appearance of the top-heavy population pyramids underscores the importance of caring for the elderly. In fact, provision of care for the elderly may be a precondition for motivation to change from high to low fertility levels. In China, the introduction in 1982 of a national scheme for old age pension reduced the resistance felt by senior family members to the one-child family.

The trends in fertility and mortality are also the main determinants of population growth, a demographic variable of key importance for economic growth and social development. In a substantial number of developing countries, rapid population growth is seen as a matter for serious concern and programmes to reduce the rate of growth receive the highest priority. Family planning is one of the important operational elements of such programmes, usually under the responsibility of the health authorities, who in most countries actively promote family planning as a health measure. It is now well documented that family planning can favourably influence the health, development and well-being of the family, particularly mothers and children through (a) avoidance of unwanted pregnancies and the occurrence of wanted births that might otherwise not have taken place; (b) a change in the total number of children born to a mother; (c) achievement of an optimal interval between pregnancies; and (d) changes in the time at which births occur, particularly the first and the last, in relation to the ages of the parents and especially that of the mother.

Perinatal mortality and other undesirable outcomes of pregnancy have been shown in many parts of the world to depend to a large extent on the age and parity of the mother and on the interval since the last birth. By reducing



the level of fertility in the high-risk mothers, family planning can also directly reduce the levels of adverse outcomes of pregnancy. Even greater gains might be attained in many developing countries where maternal mortality could be much reduced by increased access to and more judicious use of effective family planning. Thus, in Matlab, Bangladesh, almost 6 in 10 of all deaths among women in the high-risk age group 15-19 were related to pregnancy and childbirth, among women aged 20-29 more than 4 in 10, and among women aged 30-34 more than 3 in 10. The potential contribution of family planning towards preventing this excessive mortality is very great; the same is the case for deaths due to illegal abortion which occur with a frequency of 20 to 80 (or more) per million women aged 15-44 in countries where abortion is impossible or difficult to obtain legally.

In addition to the positive health effects of family planning, the ability of women to control their own fertility has opened a new set of options for women, and is seen as an essential prerequisite for their achieving full and equitable participation in social and economic development. A greater awareness of the interactions of women's status, health and development have revealed the important bearing that societal attitudes and values and differences in life-styles have on health behaviour and health status, as shown for example in sex differentials in mortality, as well as on the practice of family planning.

In rural areas, new approaches are being tested in order to extend coverage and improve the quality of maternal and child health and family planning programmes. Some of these are large-scale programmes, others are local adaptations. The common aim is to have maternal and child health and family planning care available to virtually every household. How to do this will be a major concern of health authorities over the next 10 to 20 years. The collaboration of other extension programmes will be crucial for the success of this endeavour, and in particular the close collaboration, or integration, with family planning programmes.

According to a recent world-wide survey, the total percentage of sexually active women of reproductive age practising family planning nearly doubled in some regions during the first half of the 1970s. It was estimated that, in 1976, 34 per cent of sexually active couples of reproductive age throughout the world were using some form of contraceptive method regularly.<sup>2/</sup> A comparison of rates of use of contraceptive methods by persons attending health care services in 1971 and 1976 indicates a significant increase over the five-year period. Among couples practising family planning the percentages of those using oral contraceptives or intra-uterine devices and of persons undergoing sterilization increased. However, there are wide differences within and between countries; for example, an estimated 53 per cent of sexually active women of reproductive age practised family planning in the Western Pacific region, whereas in West Africa the figure was only 3 per cent. A series of fertility surveys in all parts of the world showed that a large proportion of women wanted no more children, yet did not practice contraception. Inadequate contraceptive information and services were seen as among the main reasons for failure to meet the national population growth reduction targets set by some countries with high fertility levels and large populations. A world-wide estimate for 1982 mentions 500 million couples in



developing countries who wanted no more children, yet had no easy access to family planning information and services, a number that will nearly double by the year 2000 if present trends continue.

Some of the most important new health programmes are to be found in the area of family health. This is a particularly significant area because it is in the context of the family that the health needs of its members can be met most effectively and in ways that are easily acceptable. A sharp decrease in the early childhood mortality rates, which are currently very high, is a forceful motivation for lowering fertility rates in those areas of the world where this is considered a priority or medium-term goal. About 17 million children under five years of age died in 1978. If all the countries of the world had the same low early childhood mortality rates as those of Northern Europe, there would have been only 2 million deaths. Viewed in the light of global resources and knowledge, this is an unnecessary and disgraceful situation, reflecting a world-wide lack of commitment to closing the health gap between the rich and the poor.

In the 1970s changing patterns of social and economic development and the possibility of planning the timing and spacing of children have had an important impact on family structures and functioning. These changes have begun to influence women's and men's economic and social roles as well as the patterns of child-bearing and child-rearing and hence the health of the family. The changes in traditional family structures in some areas have left many women without adequate alternative support mechanisms - a situation that has implications for women's health as well as the health and health care of the family as a whole. In this connection should be mentioned also the trend away from breast-feeding with its serious consequences for infant health and sometimes a shortening of the birth intervals, particularly in developing countries.

In general, the priority health problem of mothers and children and their high levels of mortality and morbidity derive to a large extent from the synergistic effects of malnutrition, infection and uncontrolled fertility, themselves consequences of poor environmental and socio-economic conditions and status, including the unavailability of health care. Children who grow up deprived of adequate nutrition do less well in school than other children, and become less productive adults. It has become increasingly clear that activities and programmes in all developmental sectors, not only the health sector, are essential for the improvement of health, particularly that of mothers and children. Within the health sector, experience in different countries has shown that health activities and programmes for the families, mothers and children are more successful when they are closely linked with other essential tasks. These include education related to prevailing health problems, nutrition and communicable disease control activities, including immunization and a multidisciplinary integrated approach, ensuring the effective participation of individuals, families and communities.



### Outlook

The early part of the 1980s has not been altogether favourable for world health, and various studies of prospective economic trends undertaken by the United Nations system draw attention to the economic constraints under which the health sector may have to operate in the next decades. At the same time, it will be necessary for developing countries to profit from the experience of the developed countries in order to avoid certain undesirable effects of development such as over-emphasis on institutional health care and high cost technology, air, water and soil pollution, and energy problems, with which a number of countries are currently struggling.

Nevertheless, in the coming decades a number of factors will combine to increase health care costs. They include growing health consciousness, producing a vocal public demand for improved treatment services; extension of coverage of health care in order to remove all physical and financial barriers to its ready access and utilization; the introduction of environmental control measures to eliminate or at least to reduce potential health hazards; progress in biomedical research and health technology. At the same time, it is hoped that human development will offer the prospect of improved living standards and quality of life.

Numerical projections of changes in health status have up to now largely been limited to projections of mortality. It can be argued that such mortality projections, which are mainly extrapolations of demographic trends, are only of limited usefulness for health planners, particularly when viewed from the broader perspective of socio-economic development strategy. Projections based on trends of specific diseases and underlying causative conditions show more promise, but they are not as yet well developed. In the developing countries it may be anticipated, barring unforeseen events, that by the year 2000 the majority of their population will have a mean life expectancy at birth of at least 60 years, and that infant mortality will be in excess of 50 per 1,000 live born only in a minority of populations. Thus, the present gap in life expectancy at birth between developed and developing countries, which is estimated to be of the order of 15 to 18 years, will be almost halved by the end of this century, provided that satisfactory progress is made in all those social, economic and politico-institutional areas that influence mortality. It should be borne in mind, however, that today the gap in life expectancy at birth between the group of the least developed countries and the remainder of the developing countries is of a magnitude of about 10 years. The least developed countries will, therefore, have to achieve much greater gains if current inequalities are to be drastically reduced.

### Notes

1/ World Health Organization, "Health for All" series No. 4.

2/ Not including China or the Union of Soviet Socialist Republics.



F. Prospects of meeting the education requirements  
of growing populations

United Nations\*

Introduction

In the early part of the 1980's most countries can look back on two decades characterized by an unparalleled growth in pupil numbers. This is particularly true for the developing countries, many of whom had inherited modestly developed educational systems which were often ill-adapted to their development needs.

The last two decades saw most of these countries committed to universal primary education, and serious efforts were made to reach this target as well as other educational objectives, such as the eradication of illiteracy and the production of qualified manpower. Although the ambitious targets for educational development established in the early 1960's were not entirely met, progress made towards achieving them was considerable. There was, for example, an increase in enrolment between 1960 and 1980 of 139 per cent in primary education, 324 per cent in secondary education and 542 per cent in higher education.

In the developed countries the enrolment trends prevailing in the 1960s were considerably modified during the 1970s at all educational levels. For primary and secondary education this was brought about by a sharp fall in the birth rate which resulted in a fall in the population of primary school age beginning in 1970. Thus, primary school enrolment declined throughout the 1970's and the growth of secondary school enrolment ceased by 1980. Partly because of demographic factors, the growth of enrolment in higher education was modest by the start of the 1980's.

In spite of the educational achievements of the developing countries, a major part of their children of school age lived in countries where universal primary education had not been achieved. In 1980, 43 developing countries had primary school enrolment ratios below 90 per cent. This situation was aggravated by persistently high drop-out levels. It is estimated that, on the average, of the 82 developing countries for which data were available only 77 per cent of the pupils who started school around 1978-1979 would reach grade four of primary education.

The low academic retention rates in developing countries casts doubt on the extent to which some countries have been able to reduce illiteracy. Clearly high drop-out levels are incompatible with the attainment of educational goals such as universal primary education, the eradication of illiteracy and equality of educational opportunity.

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\* United Nations Educational, Scientific and Cultural Organization.



A factor, concomitant with enrolment growth, is the increased number of teachers required and the obvious cost implications of this. For the developed countries, the number of teachers required will increase marginally over the next 20 years. On the other hand, if the 1980 pupil-teacher ratios are to be maintained, significant numbers of new teachers will have to be recruited in the developing countries to accommodate the projected increase in enrolments.

Demographic factors will continue to play a major role in determining the ability of countries to meet the educational requirements of their populations. This is particularly true for the developing countries where the educational needs of an increasing number of young people are not being met. Demographic factors will also play an important role in the development of education in the industrialized countries. They must face the difficult problem of adjusting their education establishment to declining or fluctuating school populations.

### Past trends of the school population

#### Enrolment trends

Table 1 indicates the number of pupils enrolled in 1960, 1970 and 1980 for developed and developing countries both by level of education and by age group.

For the developed countries enrolment at the first level increased between 1960 and 1970 and decreased from 1970 onwards, leaving the number enrolled in 1980 almost the same as it had been in 1960. This pattern mirrors the pattern of population growth observed in those countries during that 20-year period. For developing countries, on the other hand, primary enrolment increased from 122 million in 1960 to 292 million in 1980, an increase of 139 per cent over the two decades.

In the developed countries enrolment at the second level of education increased by 25 million between 1960 and 1970 and grew by only 10 million in the following decade. The lesser increase was due in part to the decline in the population of secondary school age. In the developing countries almost 30 million additional students were enrolled between 1960 and 1970 and almost 45 million additional students were enrolled in the following decade.

In relative terms, the most rapid increases took place in enrolment at the third educational level. The growth rate was greatest for the developing countries, however, total enrolment was greater in the developed countries.

Table 2 presents two types of enrolment ratios for major regions expressed as percentages. The enrolment ratios by age groups relate enrolment in an age group to the population of that age group with both figures referring to the same year. The adjusted gross enrolment ratios by level of education are derived by dividing the total enrolment for that level of education, regardless of age, by the population which, according to national regulations, should be enrolled at this level of education. At the regional



Table 1. Enrolment by level and age group for developed and developing regions, 1960-1980  
(Millions)

Region <u>a/</u>	Year	1st level	2nd level	3rd level	----- Age -----		
					6-11	12-17	18-23
Developed countries	1960	124	46.4	9.6	100	65.5	13.2
	1970	138	70.5	21.1	108	91.6	28.3
	1980	125	80.6	29.7	101	95.2	38.3
Developing countries <u>b/</u>	1960	122	22.8	2.6	100	36.5	5.6
	1970	204	52.1	7.0	168	73.8	12.9
	1980	292	96.6	16.7	244	121.7	29.3

a/ See annex II for composition of regions.

b/ Not including China, the Democratic People's Republic of Korea and Namibia.



Table 2. Enrolment ratios by level of education  
and by age group, both sexes, for developed  
and developing regions, 1960-1980  
(Percentage)

Region <u>a/</u>	Year	Adjusted gross enrolment ratios			Enrolment ratios by age groups		
		1st level	2nd level	3rd level	6-11 years	12-17 years	18-23 years
Developed countries	1960	106	55	12.8	91	70	14.8
	1970	106	70	23.4	92	80	26.6
	1980	107	78	30.0	93	83	32.2
Developing countries <u>b/</u>	1960	60	13	2.0	47	21	3.7
	1970	74	22	4.3	58	31	6.9
	1980	86	31	7.4	68	39	11.2
Africa <u>c/</u>	1960	44	5	0.7	34	16	1.9
	1970	57	11	1.6	43	26	4.2
	1980	78	21	3.2	63	37	7.9
Latin America & Caribbean	1960	73	14	3.0	58	37	5.8
	1970	92	25	6.3	72	51	11.3
	1980	104	44	14.3	81	64	22.2
South Asia	1960	62	15	2.2	48	19	3.8
	1970	74	24	4.6	58	28	6.6
	1980	83	31	6.7	66	32	9.1
LDCs	1960	29	4	0.2	21	9	0.7
	1970	39	9	0.9	29	16	1.9
	1980	57	15	1.7	43	24	3.3

a/ See annex II for composition of regions.

b/ Not including China, the Democratic People's Republic of Korea and Namibia.

c/ Not including Namibia.



level the term "adjusted" indicates that the population groups used in deriving these ratios for a particular region have been obtained by taking into account the organizational structure of education in each country in that region.

In each of the six regional groupings for which enrolment ratios are given in table 2, there were increases during the 20-year period reviewed. The adjusted gross enrolment ratio for first level education in the developed countries remained stable between 1950 and 1980. For the developing countries there was an increase of 14 percentage points in the first decade and 12 percentage points in the second. For Africa, a relatively greater increase was observed in the 1970's. For the least developed countries the first level adjusted gross enrolment ratio practically doubled during the last two decades. For Latin America and the Caribbean and South Asia, less striking but important progress was made in the effort to achieve universal primary education.

At the second level of education, significant increases in enrolment ratios were observed during the past two decades in each of the regions. For developed countries the gross adjusted enrolment ratio grew from 55 per cent in 1960 to 78 per cent in 1980. The corresponding figures were 13 per cent and 31 per cent for developing countries. The enrolment ratio quadrupled for Africa and the least developed countries (LDCs), tripled for Latin America and the Caribbean, and doubled for South Asia.

The gross adjusted enrolment ratio for third level education grew faster than the other two levels of education. Between 1960 and 1980 this ratio was multiplied eight times for the LDCs, quintupled for Africa and Latin America and the Caribbean, and tripled for South Asia. This ratio quadrupled for developing countries and was multiplied two and a half times for developed countries.

#### Disparity in enrolment of boys and girls

Table 3 shows the percentage that the enrolment of girls constituted of total enrolment in each of the three levels of education in 1960, 1970 and 1980. For the developed countries the representation of girls in primary and secondary education was about equal to that of boys in each of the three years shown. The relative representation of girls in higher education increased considerably during the two decades covered. However, in spite of considerable improvement during the previous 20-year period, the enrolment of girls in the developing countries was, in 1980, markedly lower than for boys, particularly in secondary and higher education. There were also quite large differences between the three developing regions. In Latin America and the Caribbean the representation of girls in primary and secondary education was practically equal to that of boys in 1960 and girls' participation in higher education increased rapidly, from 30 per cent in 1960 to 44 per cent in 1980. However, in Africa and South Asia, the enrolment of girls was still markedly lower than that of boys in 1980, particularly in secondary and higher education, in spite of quite significant increases since 1960.



Table 3. Girls as a percentage of total enrolment  
by level of education for developed  
and developing regions, 1960-1980

Region <u>a/</u>	First level			Second level			Third level		
	1960	1970	1980	1960	1970	1980	1960	1970	1980
Developed countries	49	49	49	49	49	50	35	41	46
Developing countries <u>b/</u>	39	42	44	28	34	39	24	29	34
Africa <u>c/</u>	36	40	44	29	32	38	17	23	27
Latin America and the Caribbean	48	49	49	47	48	50	30	35	44
South Asia	36	40	41	25	31	36	24	27	31

a/ See annex II for composition of regions.

b/ Not including China, the Democratic People's Republic of Korea and Namibia.

c/ Not including Namibia.



### The number of out-of-school children

The size of the efforts still required by the developing countries to enrol children of school age can be illustrated by the number of children who were not enrolled in school in the preceding two decades. Table 4 gives the figures for out-of-school children in the age groups 6-11 and 12-17 years for 1960 and 1980.

The number of out-of-school children in the developed countries declined for the two age groups to 7.4 million for the 6-11 and 19 million for the 12-17 age groups. The overwhelming majority of the 7.4 million children in the younger age range were in countries where the normal entrance age for primary education is seven years and where six-year-olds are not eligible to enter school. In general, however, these children would have been attending pre-primary school.

For the developing countries the number of out-of-school children remained stable for the 6-11 age group but increased by some 40 per cent to 191 million for the 12-17 age group during the 20-year period reviewed. In the 6-11 age group, the number of out-of-school children remained stable in Africa, increased in South Asia, and decreased in Latin America and the Caribbean. For the 12-17 age group the number of children who did not attend school remained stable in Latin America and the Caribbean and increased by 28 per cent in Africa and 50 per cent in South Asia.

Thus, despite a relatively low enrolment growth in the developed countries, enrolment in these countries either kept pace with or exceeded population growth so that decreases in the number of out-of-school children were observed. On the other hand, apart from Latin America and the Caribbean, the number of out-of-school children in the developing countries increased despite the considerable increases in enrolment during the past two decades.

### Projected disparities in enrolment ratios between developing and developed countries by the year 2000

Table 5 shows projected adjusted gross enrolment ratios by level of education and the enrolment ratio by age groups for the next two decades for major groups of countries. These projected enrolment ratios suggest what might happen if the trends observed since 1960 were to continue.

For developed countries the stability in the primary enrolment ratio will be maintained, implying the continued provision of universal primary education. For the developing countries, increases in enrolment ratios are projected. However, the provision of universal primary education would occur only in Latin America and the Caribbean. While important progress would be made in Africa, South Asia and more so in the LDCs, a significant proportion of the primary school-aged population would still be out-of-school.

The projected enrolment ratios for second level education indicate an ever-increasing enrolment in all regions. By the end of this century, the



Table 4. Out-of-school youth, both sexes, for developed and developing regions, 1960-1980 (Millions)

Region <u>a/</u>	Age group 6-11		Age group 12-17	
	1960	1980	1960	1980
Developed countries	9.9	7.4	28.0	19.0
Developing countries <u>b/</u>	113.0	114.0	136.0	191.0
Africa <u>c/</u>	28.0	29.0	30.0	39.0
Latin America and the Caribbean	14.0	10.0	17.0	18.0
South Asia	70.0	76.0	89.0	133.0

a/ See annex II for composition of regions;

b/ Not including China, the Democratic People's Republic of Korea and Namibia.

c/ Not including Namibia.



Table 5. Projections of enrolment ratios by level of education and by age group, both sexes for developed and developing regions, 1980-2000  
(Percentage)

Region <u>a/</u>	Year	Adjusted gross enrolment ratios			Enrolment ratios by age groups		
		1st level	2nd level	3rd level	6-11 years	12-17 years	18-23 years
Developed countries	1980	107	78	30.0	93	83	32.2
	1990	106	85	34.2	93	91	36.4
	2000	105	87	37.6	93	90	39.8
Developing countries <u>b/</u>	1980	86	31	7.4	68	39	11.2
	1990	92	42	9.9	75	46	14.6
	2000	96	49	11.8	79	51	17.3
Africa <u>c/</u>	1980	78	21	3.2	63	37	7.9
	1990	88	35	5.1	4	48	12.0
	2000	93	43	6.4	80	54	15.1
Latin America & Caribbean	1980	104	44	14.3	81	64	22.2
	1990	107	59	21.0	86	73	29.5
	2000	109	67	25.9	89	77	35.2
South Asia	1980	83	31	6.7	66	32	9.1
	1990	89	40	8.5	72	38	11.3
	2000	93	47	10.1	77	42	13.4
LDCs	1980	57	15	1.7	43	24	3.3
	1990	71	23	3.1	55	32	5.7
	2000	82	32	4.4	63	40	8.1

a/ See annex II for composition of regions.

b/ Not including China, the Democratic People's Republic of Korea and Namibia.

c/ Not including Namibia.



developed countries are expected to enrol the equivalent of 87 per cent of the children of secondary school age while in the developing countries just under 50 per cent should be enrolled. Among the regions of the developing countries, Latin America and the Caribbean are projected to have two thirds of their school-age population enrolled, South Asia 47 per cent, Africa 43 per cent and the LDCs about one third by the end of the century.

In third level education, as for second, the projected trend is for an increasing enrolment in all regions. Despite the increases projected, the gap between the developing countries and the developed countries would remain considerable except in the case of Latin America and the Caribbean.

Looking at the enrolment ratios by age groups, it may be observed that for the developed countries 90 per cent or more of the children in the age groups 6-11 and 12-17 years will be enrolled together with almost 40 per cent of the 18-23 age group. Among the developing countries, only those in Latin America and the Caribbean are expected to approach the enrolment ratios observed for developed countries. For the remaining developing countries, slow and steady increases in the numbers enrolled are projected.

#### Progress towards universal primary education by the year 2000

To continue the enrolment trends of the last two decades would, according to the projections presented in this paper, result in an adjusted gross enrolment ratio for primary education in the developing countries in the year 2000 corresponding to about 96 per cent of their population of primary school age. The corresponding figures would be 93 per cent for Africa and South Asia. However, these global averages mask very different levels of development of primary education within as well as between different developing nations.

First, a number of school places are used by repeaters and the level of repetition varies quite considerably between countries. Second, the enrolment ratios in table 5 refer to both sexes together and thus hide quite important (although declining) differences in enrolment between boys and girls. In primary education, these differences are almost exclusively limited to countries in Africa and South Asia. The projections for the year 2000 imply a primary school enrolment ratio of 88 per cent for girls as compared to 98 per cent for boys in Africa and 85 per cent for girls as compared to 100 per cent for boys in South Asia. Thus, at this level of aggregation, one of the main obstacles to the attainment of universal primary education by the year 2000 in these two regions appears to be the comparatively low enrolment rate of girls.

The main concern of most developing countries during the past two decades has been to increase access to education by providing more schools. However, at the beginning of the 1980's, when most countries had achieved enrolment ratios exceeding 80 per cent, the main concern was to improve the internal efficiency of the system and to enrol population groups that traditionally have enrolment ratios below the national average. One aspect of this problem is the disparity in enrolment ratios between boys and girls. Another aspect is the need to provide more educational opportunities for population groups



which, due to their area of residence, ethnic and socio-economic background, traditionally have benefitted less from education than other groups.

Finally, the average enrolment ratios shown in table 5 mask the fact that if past trends were to continue, the failure to achieve universal primary education in the year 2000 would mainly be due to a comparatively slow enrolment growth in some countries. These countries would be in Africa and South Asia, and most of them would belong to the LDCs. Thus, among the developing countries, 23 would in the year 2000 have enrolment ratios below 90 per cent (as compared with 43 in 1980). Eighteen of these 23 countries would be in Africa and 5 in South Asia. Furthermore, 16 of these 23 countries would belong to the group of least developed countries.

#### The impact of population growth

Enrolment ratios depend on the size of the population concerned. Any projection of these ratios has to make assumptions on the rate of increase of population. The projections presented in this paper are based upon the "medium" population variant as established by the United Nations Population Division.

Table 6 shows the percentage by which the population aged 5-14 years would increase between 1980 and 2000 according to the three population variants. Using the growth of this age group as a proxy for the growth of the population of primary school age, the following salient features can be observed:

(a) The considerable range the projections of the future population of school age. The developing countries population of primary school age in the year 2000 could be between 25 per cent and 51 per cent larger than that of 1980;

(b) The marked difference in projected future population growth between the developed and developing countries. According to the medium variant, the increase in the primary-school-age population between 1980 and 2000 would be more than 20 times higher in the developing than in the developed countries;

(c) The considerable difference in the projected growth between the three developing regions. For example, the percentage growth implied for the low variant in Africa is of the same magnitude as that implied by the high variant for Latin America and the Caribbean.

Table 6 indicates that, to keep pace with projected population growth, that is, to maintain in the year 2000 the primary school enrolment ratios attained in 1980, the developing countries would have to increase their primary school enrolment by some 25 per cent according to the low population variant and 51 per cent according to the high variant. To increase the enrolment ratio would, of course, imply even higher growth. Thus, to attain a projected ratio of 95 per cent by the year 2000, the developing countries would (under the medium variant) have to increase their enrolment by 55 per cent between 1980 and 2000 while the enrolment increase would have to be of



100

100

Table 6. Percentage increase in population aged 5-14 years between 1980 and 2000, by population variant, for developed and developing regions

Region <u>a/</u>	Low variant	Medium variant	High variant
Developed countries	-9.3	1.9	10.7
Developing countries <u>b/</u>	24.7	40.1	50.7
Africa	47.7	84.6	95.4
Latin America and the Caribbean	26.5	37.9	48.9
South Asia	17.2	26.4	36.7

a/ See annex II for composition of regions.

b/ Not including China and the Democratic People's Republic of Korea.



the order of 63 per cent to achieve 100 per cent enrolment. Corresponding figures for Africa are 125 per cent and 137 per cent, respectively.

The high enrolment growth required in the developing countries even to maintain their comparatively lower enrolment ratios is in stark contrast to the situation in the developed countries which, according to the medium variant, would be able to maintain their universal enrolment by a mere 2 per cent increase in enrolment during this 20-year period. Enrolment could even decrease if the low variant were to hold true. This does not, however, mean that population factors will not play an important role in the future educational development of the developed countries. This is particularly so because of the fluctuations which occur in their population of school age.

#### The projected number of out-of-school children

Table 7 shows a projected decline in the number of children aged 6-11 years not enrolled in school for all developing countries between 1980 and 2000. The minimal increase in the case of the developed countries is explained firstly by a decreasing population and secondly by the fact that in a certain number of these countries primary education begins at age seven. For the developing countries, on the other hand, although the number of out-of-school children should decrease in the next 20 years, by the year 2000 more than 100 million children in the age group 6-11 will still not attend school.

For the developed countries the number of children in the age group 12-17 years not enrolled in school is projected to decrease to 12 million in the year 2000. On the contrary, for all developing countries except Latin America and the Caribbean, where a small decrease is projected, important increases are projected in the number of out-of-school children in this age group.

#### Reduction in the number of illiterate children

The figures given in table 5 suggest that by the year 2000 the number of children enrolled in primary schools in developing countries would be equivalent to 96 per cent of the primary-school-age population. The corresponding figure for 1980 is estimated to be 86 per cent. However, as enrolment ratios are affected by repetition and drop-out, they give a very approximate picture of the potential proportion of a region's primary school population eligible to complete this level of education.

The performance of an educational system should be measured in terms of the quantity as well as the quality of the output. Although the output is difficult to define in measurable terms, in the case of primary education one might argue that the main objective is to make the pupils literate. To attain this goal, it is not only necessary that children enter the first grade of primary education, but also that they remain enrolled for a sufficient number of years.



Table 7. Out-of-school youth, both sexes, for developed and developing regions, 1980-2000  
(Millions)

Region <u>a/</u>	Age group 6-11		Age group 12-17	
	1980	2000	1980	2000
Developed countries	7.4	7.9	19.0	12.0
Developing countries <u>b/</u>	114.0	103.0	191.0	222.0
Africa <u>c/</u>	29.0	29.0	39.0	55.0
Latin America & Caribbean	10.0	9.0	18.0	16.0
South Asia	76.0	66.0	133.0	152.0

a/ See annex II for composition of regions.

b/ Not including China, the Democratic People's Republic of Korea and Namibia.

c/ Not including Namibia.



The point at which the cessation of schooling becomes "dropping out" and hence a problem depends on the structure and the objectives of the educational system of each country. In the industrialized nations, any drop-out taking place during the 8-10 years of compulsory schooling is clearly considered to be a problem. Even to leave school after having completed only this compulsory period is regarded as undesirable in many countries, particularly during the present period of high levels of youth unemployment and also because a large proportion of these early school leavers often belong to socially disadvantaged groups. In developing countries, where the stress is generally still on achieving universal primary education, drop-out from primary education, particularly prior to the attainment of literacy, is a matter of serious concern.

To illustrate the considerable magnitude of the level of drop-out in many developing countries, the progression of cohorts through primary education has been estimated for all countries for which the required statistical information was available. The information is summarized in Table 8 which shows survival to the final grade of primary education, should the promotion, repetition and drop-out rates observed around the period 1978-1979 remain stable in the future.

The first two columns of this table give, for four major regions, the range and the median value of the percentage of the cohort dropping out prior to the final grade of primary education, while the next three columns classify countries according to their level of drop-out.

The figures shown in table 8 illustrate the relatively high level of drop-out in the developing regions as well as the considerable disparity between as well as within regions.

To provide an indication of survival and drop-out by grade, table 9 shows average progression rates by grade until grade four for groups of countries. The rates are weighted to take account of differences between countries with respect to the magnitude of their enrolment, levels of repetition and drop-out in primary education. The countries included represented in 1978-1979 some 60 per cent of the primary school enrolment in Africa, some 88 per cent in Latin America and the Caribbean and 41 per cent in Asia and Oceania. The comparatively low coverage for Africa, Asia and Oceania is due to the exclusion of a large number of countries for which the required data were not available.

Table 9 shows that, on the average, for the 82 developing countries covered, 77 per cent of the pupils starting school around 1978-1979 would reach grade four, should the promotion, repetition and drop-out rates observed at that time remain constant in the future. The drop-out rates between grades one and two are high. The level of drop-out is particularly high in Latin America and the Caribbean, especially between grades one and two.

The low retention shown above casts doubt on the extent to which the educational systems in some developing countries, despite the rapid growth of enrolment during the last 20 years, were able to tackle successfully the problem of eradicating illiteracy. It also calls into question the



Table 8. Classification of countries according to level of drop-out prior to the final grade of primary education, for cohorts starting school around 1978-1979, both sexes <sup>a/</sup>

Region	Range in drop-out (%)	Median drop-out (%)	Number of countries where the percentage of the cohort dropping out prior to the final grade was:			Total countries
			50% and above	Between 49% & 25%	24% and below	
	(1)	(2)	(3)	(4)	(5)	(6)
Africa	6 - 72	33	6	19	10	35
Latin America & the Caribbean	11- 70	33	6	10	4	20
Asia & Oceania	0 - 75	11	4	4	21	29
Europe	0 - 23	5	0	0	17	17
Total	0 - 75	24	16	33	52	101

<sup>a/</sup> All estimates concerning surviving and drop-out presented in this section are derived by means of the Reconstructed Cohort Method. On the basis of data on promotion, repetition and drop-out rates, this method permits us to estimate the progressions of a cohort through a cycle of education, deriving for each grade and year how many pupils repeat a given grade, are promoted to the following grade or drop out. For a detailed description of this method, see *A Statistical Study of Wastage at School, Studies and Surveys in Comparative Education*, (United Nations Educational, Scientific and Cultural Organization, Paris-Geneva, IBE, 1972).



Table 9. Weighted average progression rates by region for cohorts starting primary education around 1978-1979 and percentage of primary enrolment by major region, both sexes a/

Group of countries and regions	Number of countries	Percentages of 1978-1979 cohort reaching grade:				% of region's primary enrolment
		1	2	3	4	
Average developing countries	82	1000	86	82	77	55
Africa	35	1000	89	85	80	60
Latin America & Caribbean	20	1000	78	71	66	85
Asia and Oceania	29	1000	93	90	87	41
Europe	17	1000	99	98	98	64

a/ These weighted averages were derived by reconstructing cohorts for each region, using regional promotion, repetition and drop-out rates calculated on the basis of data on enrolment and repeaters by grade for the total region.



significance of high enrolment ratios if a large proportion of the children drop out before even becoming literate. For example, although in 1980 Latin America and the Caribbean had enrolment ratios which were considerably higher than those of Africa, in terms of the "production" of literate children, the difference between the two continents might be much smaller.

#### Projected disparities in enrolment between boys and girls

The growth in enrolment of boys and girls between 1960 and 1980 was analysed in the introduction. If the same trends prevail for the next 20 years, the gap between developed and developing countries would narrow for all levels of education. This is shown in table 10.

By the year 2000 parity in enrolment between the sexes is projected to occur at all levels of education in the developed countries and Latin America and the Caribbean. In Latin America and the Caribbean, however, female enrolment is projected to be stationary at 45 per cent of total third-level enrolment between 1990 and 2000.

For Africa and South Asia, parity in enrolment between the sexes is not projected to be achieved at any level of education by the year 2000. However, individual countries in these two regions would have eliminated disparities in enrolment between the sexes. Although inequalities by sex would remain, progress is anticipated with a consequent narrowing of the gap.

#### Number of teachers required

The increases in enrolment ratios projected for the next two decades imply that an increase in the number of teachers will be required if the pupil-teacher ratios, observed in 1980, are to be maintained. Table 11 provides the past and projected number of teachers for each decade in the period 1960-2000.

From table 11, it can be seen that for the developed countries relatively marginal increases in the number of teachers are required to maintain the 1980 pupil-teacher ratio for each of the three levels of education.

In the developing countries, substantial increases in the number of teachers will be required for all levels of education throughout the next two decades if present pupil-teacher ratios are to be maintained. For first-level education, a 56 per cent increase in the teaching force is expected between 1980 and the end of the century. For second level education the number of teachers is projected to more than double during the next 20 years. For third-level education, the projected number of teachers in the year 2000 should also be more than twice the 1980 figure. By the year 2000, for each of the three levels of education, there will be more teachers in the developing countries than in the developed countries.



Table 10. Girls as a percentage of enrolment by level of education, for developed and developing regions, 1980-2000

Region <u>a/</u>	First level			Second level			Third level		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Developed countries	49	49	49	50	50	50	46	47	48
Developing countries <u>b/</u>	44	45	46	39	42	44	34	37	39
Africa <u>c/</u>	44	46	47	38	43	44	27	30	32
Latin America & Caribbean	49	49	49	50	50	50	44	45	45
South Asia	41	43	45	36	39	41	31	34	37

a/ See annex II for composition of regions.

b/ Not including China, the Democratic People's Republic of Korea and Namibia.

c/ Not including Namibia.



Table 11. Teacher requirements for developed and developing regions,  
1960-2000  
(Millions)

Region	Level of education	1960 <u>a/</u>	1970 <u>a/</u>	1980 <u>a/</u>	1990 <u>b/</u>	2000 <u>b/</u>
Developed countries	1st	4.8	5.6	5.7	6.0	6.1
	2nd	2.3	6.0	6.1	6.1	6.5
	3rd	0.7	1.5	2.3	2.4	2.7
Developing countries	1st	3.4	5.6	8.5	10.9	13.3
	2nd	1.2	2.8	4.9	7.9	11.0
	3rd	0.2	0.5	1.3	2.1	3.0

a/ Actual figures.

b/ Projected figures based on 1980 pupil teacher ratio of 22 (developed countries) and 34 (developing countries) for first-level education, 13 (developed countries) and 19 (developing countries) for second-level education and 13 for third-level education for both developed and developing countries.



## ANNEX I

### TRENDS IN FEMALE LITERACY

#### Introduction

In 1980 there were an estimated 824 million illiterates in the world and in spite of national efforts to combat illiteracy, that number is likely to continue to increase. Though illiteracy rates are falling world-wide, the absolute number continues to grow, and is projected to reach over 900 million by the end of the century. Furthermore, 60 per cent of all illiterates in the world are women and their number is growing more rapidly than that of their male counterparts.

In most developing countries, the figures of high illiteracy (and in particular, female illiteracy) coincide with a high rate of population growth. Therefore, rapid population growth constitutes one of the main obstacles to attaining crucial quantitative educational targets. Not only do the educational systems have to expand to cope with a growing population, but they have to be modified, improved and adapted to the needs of the country's stage of development.

The rates at which population grows in the different regions affect the age profile of their populations. In developing regions, fertility levels vary widely: it is high and stable in many countries, declining in some others and increasing in only a few. Mortality levels also vary considerably: life expectancy ranges between 40 and 70 years and infant mortality between 20 and 200 per thousand live births. Accordingly, the age structures of the populations in developing areas are characterized by the predominance of young people (up to 45 per cent of the population is below 15 years, see table 12).

In spite of the global fertility decline of the past 10 to 15 years, the world population continued to grow rapidly and this is particularly true in Africa and the least developed countries (LDCs). In addition, the present young age structure of the population in the developing regions interacting with rapid fertility decline would still entail a rate of natural increase above 2.0 per cent in most of the developing areas with the exception of Asia where at the turn of the century the growth rate will be reduced to 1.5 per cent.

The needs for educational facilities and teaching personnel are obviously closely connected with the current and projected numbers of the population of school age. The larger the proportion of school-age children in the population, the greater is the proportion of national income that has to be spent to provide education.

Therefore, the demographic expansion, together with limited resources, force Governments to set priorities such as: expanding and improving the traditional educational system, and/or fighting adult illiteracy and/or encouraging and increasing female education. Developed countries do not have to face increased proportions of children at school age and so they



Table 12. Percentage distribution of major age groups  
(0-14 years, 15-44 years) in the world, major regions  
and groups of countries, 1970-2000

	Total	Population aged 0-14				Population aged 15-44			
		1970	1980	1990	2000	1970	1980	1990	2000
World	100	37.5	35.0	32.4	30.7	42.4	44.4	46.6	46.6
Developed countries	100	26.8	23.6	22.6	21.8	43.6	44.8	44.6	42.8
Developing countries <u>a/</u>	100	41.9	39.1	35.4	33.2	42.0	44.3	47.3	47.6
Africa	100	44.6	44.9	45.2	43.9	41.4	41.3	41.3	42.6
Asia	100	40.4	37.3	32.5	29.9	42.6	45.0	48.5	48.6
Latin America and Caribbean	100	42.6	39.8	37.2	34.7	41.6	43.9	46.1	46.9
Arab countries <u>b/</u>	100	44.9	43.9	43.1	40.4	40.8	41.9	42.8	44.8
Least developed countries <u>1/</u>	100	44.7	45.0	44.9	43.2	41.2	41.4	42.1	43.6

Source: Based on Demographic Indicators of Countries: Estimates and Projections as Assessed in 1980, (United Nations publication, Sales No. E.82.XIII.5 and corrigendum).

a/, b/ and c/, see annex II.



concentrate their efforts on the improvement of the educational system and the raising of the general level of educational attainment. The developing countries, on the other hand, usually must concentrate on extending basic education to the disadvantaged sections of the population - for instance, women and the rural population.

### Female literacy

Table 13 shows the past and projected literacy situation in the world for the population aged 15 years and over during the period 1970-2000. Since 1970, notable progress has been made in the struggle against illiteracy, world-wide. For example, the number of literate adults rose by 33 per cent in 10 years. Furthermore, the number of literate adults is and will remain, at least up to the year 2000, far higher than that of illiterate adults. Unfortunately, this picture has a dark side.

During the last decade, the absolute number of illiterates increased by 64 million, rising from 760 million to 824 million in 1980. If the current trends do not change, the total number of illiterates will have increased by 88 million by the end of the century. Thus, mankind will begin the year 2000 with just under one billion illiterate men and women.

It is therefore evident that despite the unprecedented achievements in this field, the problem of illiteracy is likely to become more acute if the national authorities as well as the international agencies concerned do not act with increased determination and on a larger scale.

Female literacy is even a greater problem. Table 14 presents the evolution of the literacy situation in the world with particular reference to the female population.

Though the percentage of female illiterates has declined, the absolute number has increased. The female illiteracy situation as compared to that of the male is presented in table 15. Females are at a disadvantage in all regions and groups of countries except Latin America and the Caribbean, since more than 50 per cent of the illiterates elsewhere are women, regardless of their age group. Furthermore, the projected trend during the 1970-2000 period does not indicate an improvement of the distribution of illiteracy between the sexes.

### Female illiteracy

#### Female illiteracy in the age group 15 years and over

Table 16 shows the distribution of the illiterate female population by the major regions and groups of countries.

The developing countries are increasing their share of illiterate women to such an extent that by the end of the century, only an insignificant proportion of the world's illiterate women will be found in developed



Table 13. Evolution of literacy in the world  
for the population aged 15 years and over, 1970-2000

	1970	1980	1990	2000
Population (millions)	2310	2879	3546	4242
Number of literates (millions)	1550	2055	2664	3330
Number of illiterates (millions)	760	824	882	912
Percentage of illiterates	32.9	28.6	24.9	21.5



Table 14. Evolution of literacy in the world for the female population aged 15 years and over, 1970-2000

	1970	1980	1990	2000
Female population (millions)	1 164.5	1 447.3	1 775.5	2 118.7
Number of literates (millions)	721.9	956.5	1 243.2	1 567.1
Number of illiterates (millions)	442.6	490.8	532.2	551.6
Percentage of illiterates	38.0	33.9	30.0	26.0



Table 15. Percentage of women in total illiterate population  
by age group, for major regions and groups of countries, 1970-2000

	15 and over				15-19 years				15-44 years			
	1970	1980	1990	2000	1970	1980	1990	2000	1970	1980	1990	2000
World	58.2	59.6	60.3	60.5	59.8	59.2	57.4	54.6	59.3	60.6	61.0	60.1
Developed countries	62.0	62.9	...	...	49.1	49.0	...	...	56.5	54.7	...	...
Developing countries	58.1	59.5	60.3	60.5	59.9	59.3	57.4	54.6	59.3	60.6	61.0	60.1
Africa	58.0	59.7	61.4	62.6	60.7	60.6	61.1	59.2	59.1	61.0	62.9	63.5
Asia	58.2	59.6	60.3	60.2	60.3	59.4	57.2	54.1	59.6	60.9	60.9	59.7
Latin America and the Caribbean	55.8	55.9	55.6	55.0	50.3	46.4	42.8	35.8	55.0	54.3	53.0	50.4
Arab countries	59.1	61.1	62.9	63.9	62.3	63.3	63.6	61.0	60.6	62.6	64.4	65.1
Least developed countries	55.4	57.0	58.6	59.7	56.7	57.8	59.4	58.3	55.9	57.6	59.5	60.5



Table 16. Percentage distribution of illiterate female population aged 15 and over, by major regions and groups of countries, 1970-2000

	1970	1980	1990	2000
World	100	100	100	100
Developed countries	4.0	2.9	...	...
Developing countries	96.0	97.1	97.9	98.4
Africa	18.3	19.0	19.0	19.0
Asia	72.5	73.4	74.7	75.7
Latin America and the Caribbean	5.6	5.0	4.4	3.8
Arab countries	6.5	7.1	7.5	8.0
Least developed countries	11.9	12.8	13.7	14.9



regions. Asia, the Arab countries and the least developed countries will steadily increase their contribution to the total number of illiterates, while that of Latin America will decrease and Africa's share will remain constant.

In spite of the rather steep decline in the female illiteracy rates over the next two decades, the absolute number of illiterate adult women in the world will increase by 61 million over the same period: from 491 million in 1980 to 552 million in 2000. Since their number will actually decrease by 5 million in the developed countries and by another 4 million in the Latin American and Caribbean region, Africa and Asia will be left with a net increase of 70 million illiterate adult women. The Arab countries and the least developed countries will also add 9 million and 19 million to the ranks of illiterate women, respectively. The reason for these increases lies mainly in the demographic factor, the growth of population.

In 1980, the female illiteracy rate, for the world, was higher than the male illiteracy rate; and the disparity is likely to persist well into the next century if the present trends continue. Nevertheless, the difference in rates is expected to decrease gradually, for example, from 10.6 percentage points to 9.0 percentage points over 20 years. This will also be true of the major developing regions and groups of countries. However, it should be noted that even by the year 2000, the disparity will exceed 10 percentage points in all the developing regions except Latin America and the Caribbean.

In 1980, the number of illiterate adult women in the world was higher than that of their male counterparts by 158 million. The corresponding figure in 2000 is expected to be 192 million, an increase of 34 million, in spite of the fact that the disparity between the female and male illiteracy rates would have decreased over the same period. Thus, the numerical advantage in favour of illiterate adult men is not only likely to continue to the end of the century, but the gap between the two sexes will widen by 34 million.

#### Adults aged 15 to 44 years

In 1980, the world had 315 million illiterate women aged 15-44 years, of whom 312 million (99.0 per cent) were to be found in the developing countries. Table 17 presents the relative distribution of female illiterate adults aged 15 to 44 in the world by major regions and groups of countries.

In 1970, 98.5 per cent of the world's illiterate women aged 15-44 were to be found in developing areas and this proportion will increase to over 99 per cent in 2000. Over the 1970-2000 period, Africa will account for one fifth of the illiterate women in the world; Asia will increase its contribution by 3.7 percentage points; and the Arab countries by 1.5 percentage points. The least developed countries contributed 13.1 per cent in 1970 which will increase to 17.4 per cent in 2000. Once again Latin America and the Caribbean will succeed in reducing their share of female illiteracy.

In 1980, in the world as a whole, 32.5 per cent (or just under one third) of the women aged 15-44 years were illiterate. The corresponding figure for the developed and the developing countries was 1.1 per cent and 43.9 per cent,



Table 17. Percentage distribution of illiterate females aged 15-44 years, by major regions and groups of countries, 1970-2000

	1970	1980	1990	2000
World	100	100	100	100
Developed countries	1.4	1.0	0.7	...
Developing countries	98.5	99.0	99.3	...
Africa	19.2	19.9	19.4	19.2
Asia	74.3	75.1	76.6	78.0
Latin America and the Caribbean	5.1	4.2	3.3	2.3
Arab countries	6.9	7.5	7.8	8.4
Least developed countries	13.1	14.2	15.6	17.4



respectively. In other words, while almost all the women in this age group in the developed countries had attained the literate status, that was true of less than three fifths of the women aged 15-44 years in the developing countries.

The female illiteracy rates in the developing regions showed a wide range of variation: from 16.7 per cent in Latin America and the Caribbean region to 64.0 per cent in Africa, with Asia standing at 41.8 per cent. As groups of countries, the Arab countries and the least developed countries, with their female illiteracy rates of 70.0 per cent and 79.3 per cent, respectively, were well above the rates for the rest of the developing countries.

In the year 2000, the female illiteracy rate for the age group 15-44 years for the world as a whole is projected to be 22.2 per cent, down 10.3 percentage points from 32.5 per cent in 1980. In the developing countries, the rate is expected to drop by 16.3 percentage points to 27.6 per cent. Likewise, Africa, Asia and Latin America and the Caribbean are expected to reduce substantially their female illiteracy rates for this age group.

According to projections made in 1982 by the Office of Statistics of UNESCO, the world will have, by the end of the century, 311 million illiterate women aged 15-44 years, showing a decrease of 4 million (1.3 per cent) from the 1980 figure. Likewise, Africa will witness a decrease of 3 million (4.8 per cent) and Latin America and the Caribbean is expected to reduce its number of illiterate women by 6 million (46.2 per cent). On the other hand, Asia, the Arab countries and the least developed countries will have added 6 million, 2 million and 9 million, respectively, to the ranks of illiterate women, despite the substantial decrease in the female illiteracy rates for this age group over the next 20 years.

In 1980, for persons aged 15-44, the female illiteracy rate in the world as a whole was higher than the male illiteracy rate; and the disparity in favour of men is likely to persist well into the next century if the present trends continue. Nevertheless, it is expected that the difference between female and male illiteracy rates will decline from 12 percentage points in 1980 to 8 percentage points by 2000. The gap between the two sexes is therefore narrowing - at the average rate of one percentage point in five years. However, in all the developing regions of the world, except in Latin America and the Caribbean, the disparity between the female and male illiteracy rates for this age group was substantial (more than 10 percentage points). It is estimated that by the year 2000, the disparity will disappear in that region (as in the developed countries), but will remain considerably high in the other developing regions.

In 1980, the number of illiterate women in the age group 15-44 years was higher than that of their male counterparts by 110 million. It is expected that this figure will decline to 104 million by 2000 (or by 5.5 per cent over 20 years). Similar decreases are expected in the developed countries, the developing countries as a group, in Asia and in the Latin American and Caribbean region. However, the gap between the two sexes will widen in Africa, the Arab countries, and the least developed countries.



### Age group 15-19 years

The age group 15-19 years may be considered as a touchstone for the evaluation of the future prospects of the struggle against female illiteracy.

Table 18 presents the percentage distribution of illiterate females aged 15-19 years in each region and group of countries. Less than one per cent of the world's illiterate females between 15 and 19 years lives in the developed areas. Comparing data for 1970 and for 2000, Africa's share will remain fairly steady, Asia's share will increase, as well as that of the Arab countries and of the least developed countries. Only Latin America and the Caribbean's share of the illiterate females is expected to decline sharply.

In 1980, in the world as a whole, 27.5 per cent (or over one quarter of the women aged 15-19 years) were illiterate. The corresponding figure for the developed and developing countries was 0.7 per cent and 35.0 per cent, respectively. Thus, while almost all the women in this age group in the developed countries had attained literate status, over one third of the women of this age group in the developing countries were still unable to read and write.

The female illiteracy rate for this age group varied from 7.6 per cent in the Latin American and Caribbean region to 51.8 per cent in Africa, with Asia standing at 34.7 per cent. As groups of countries, the Arab countries and the least developed countries, with their female illiteracy rates of 56.8 per cent and 69.2 per cent, respectively, were worse off than Africa. In this respect, the situation for this age group was similar to that for the 15-44 group.

In 1980, there were 60.8 million illiterate women aged 15-19 years, of whom 60.4 million (99.5 per cent, or almost all) were to be found in the developing countries. Asia's contribution was 46.5 million or 76.5 per cent.

It is expected that by the year 2000, the female illiteracy rate for the age group 15-19 years for the world as a whole will decline to 17.3 per cent, i.e., by 10.2 percentage points. The decline will be even higher in the developing countries. None the less, the female illiteracy rates will still be relatively high in all of them.

Along with the fall in the female illiteracy rate, the number of illiterate women in this age group in the world will decrease from 60.8 million in 1980 to 47.0 million in 2000, i.e., by 13.8 million or 22.7 per cent. The decrease will be shared by all the developing regions and groups of countries.

In 1980, the number of illiterate women aged 15-19 years was higher than that of their male counterparts by 18.9 million. It is expected that this figure will decline to 7.9 million (or by 58.2 per cent by 2000). Similar decreases are expected to take place in all the developing regions and groups of countries.



**Table 18. Percentage distribution of illiterate females  
aged 15-19 years, by major regions and groups of countries, 1970-2000**

	1970	1980	1990	2000
World	100	100	100	100
Developed countries	0.7	0.5	0.7	...
Developing countries	99.3	99.4	99.3	...
Africa	19.2	20.7	17.9	18.9
Asia	75.7	76.5	79.7	78.9
Latin America and the Caribbean	4.6	2.5	1.8	1.5
Arab countries	7.2	8.1	8.2	9.1
Least developed countries	14.7	16.3	17.9	20.6



In conclusion, the literacy of women aged 15-19 years is expected to improve considerably over the next 20 years or so. The improvement for this age group will be greater than for the 15-44 age group. However, it should be noted that the disparities between regions and groups of countries are somewhat more striking for this age group than for the other age groups. No doubt, the low illiteracy rates are the result of high enrolment ratios during the past decade.

#### Population dynamics and the evolution of female illiteracy.

Though the total number of illiterate women in the age group 15 years and over is projected to increase from about 491 million in 1980 to approximately 552 million in the year 2000, the number of illiterate women in the 15-19 age group is expected to decrease by 14 million from about 61 million in 1980 to 47 million by the end of the century. On the other hand, the number of illiterate women in the age group 20-44 years is expected to increase by about 10 million over the period under study after an increase by about 16 million during the 1980s. By far the largest increase will be for the age group 45 years and over. By the year 2000 the number of illiterate women in this age group will have risen by about 64 million.

However, tables 19 and 20 show more encouraging trends. They present for three age groups for the world and major regions, the average annual growth rates of the female population and of the female literate population over the 1970-2000 period. The figures indicate that for all regions and groups of countries, developed countries left out, the rates of growth of the literate female population are higher than the growth rate of the total female population. The rates are particularly high in Africa, in the Arab countries and in the least developed countries.

#### Illiteracy and fertility

If high population growth rates are directly responsible for the increasing number of illiterates, an important question arises: could illiteracy be in turn responsible for high population growth?

The substantially expanding literature on the relationship between women's education and fertility is divided on its exact nature and degree. In many instances research on fertility indicates that education, especially when examined in conjunction with other predictors, can account for a significant portion of fertility differences among various social and economic strata of a population. But in other instances there appears to be little or no effect upon fertility trends in the developing world of either education or literacy, with the nature and degree of the relation depending on a myriad of other independent variables that impinge on fertility rates especially at the micro-level, such as female participation in the labour force outside the agricultural sectors, infant mortality, income, life expectancy at birth, crude death rate, urbanization, energy consumption per capita, marriage age, women's status, type of residence and family planning programme effort. Examined in isolation, i.e., out of the context of socio-cultural and economic



Table 19. Average annual rate of growth of female population  
and major regions, 1970-2000  
(Percentage)  
(Female population)

Region	15 and over				15-19 years				15-44 years			
	1970- 1980	1980- 1990	1990- 2000	1970- 1980	1980- 1990	1990- 2000	1970- 1980	1980- 1990	1990- 2000	1970- 1980	1980- 1990	1990- 2000
World	2.2	2.1	1.8	2.1	1.3	0.8	2.3	2.2	1.5			
Developed countries	1.2	0.8	0.6	0.6	-0.9	0.5	1.0	0.6	0.1			
Developing countries	2.7	2.6	2.2	2.6	1.8	0.8	2.8	2.7	1.9			
Africa	2.7	3.0	3.2	3.1	3.0	3.4	2.8	3.0	3.3			
Asia	2.6	2.5	1.9	2.3	1.6	0.0	2.6	2.5	1.5			
Latin America and the Caribbean	3.0	2.8	2.5	3.0	1.7	1.8	3.1	2.8	2.3			
Arab countries	3.1	3.1	3.2	3.6	2.6	3.2	3.2	3.1	3.2			
Least developed countries	2.5	2.8	3.0	3.0	2.8	3.1	2.6	2.9	3.1			

Source: Calculated from Demographic Indicators of Countries: Estimates  
and Projections as Assessed in 1980 (United Nations publication, Sales No.  
F 87.XIII.5 and corrigendum).



Table 20. Average annual rate of growth of female literate population in the world and major regions, 1970-2000  
(Percentage)  
(Literate females)

Region	15 and over				15-19 years				15-44 years			
	1970-1980	1980-1990	1990-2000	1970-1980	1980-1990	1990-2000	1970-1980	1990-2000	1970-1980	1980-1990	1990-2000	1970-1980
World	2.9	2.7	2.3	2.9	2.1	1.4	3.2	3.0	3.2	3.0	2.2	3.2
Developed countries	1.3	...	...	0.6	...	...	1.1	...	1.1	...	...	...
Developing countries	4.5	4.1	3.3	4.1	3.1	1.6	4.8	4.2	4.8	4.2	3.0	4.8
Africa	7.1	6.9	6.1	5.7	6.9	4.9	7.1	6.9	7.1	6.9	5.9	7.1
Asia	3.9	3.6	2.7	3.5	2.7	0.6	4.2	3.7	4.2	3.7	2.3	4.2
Latin America and the Caribbean	4.1	3.6	3.1	4.3	2.1	2.0	4.2	3.6	4.2	3.6	2.8	4.2
Arab countries	8.5	7.3	6.3	7.1	6.0	5.0	8.5	7.3	8.5	7.3	6.0	8.5
Least developed countries	7.5	7.7	6.9	8.1	7.3	5.8	7.7	7.9	7.7	7.9	6.8	7.7



development variables and the rest of the related independent fertility determinants, education and literacy in themselves may have some effect on fertility reduction. Yet, in other instances, research has shown mixed results.

In low-fertility countries, education at certain levels may have a positive effect on fertility such as at higher levels of the wife's educational attainment. As in many developed countries the effects of the wife's education are rather weak (Finland, Netherlands, Norway, United Kingdom), while in others (e.g., Hungary and Poland) they are stronger, it is difficult to consider the wife's education in the developing world as a predictor of fertility increase or decrease, all other independent variables being equal.

Since the relationship between literacy and fertility behaviour cannot be clearly established unless considered along with other development factors, it may be worthwhile to consider literacy as a development indicator, for it is development as a whole that is generally thought to have a stronger effect on fertility.

### Summary

Despite efforts during the past few decades to reduce illiteracy in many developing countries, it will continue to afflict an increasing number of the world's population well into the twenty-first century. The percentage of illiterate people will decrease; but as a result of rapid population growth, their numbers will not diminish.

High rates of population growth place increasingly heavy burdens on educational facilities, and render very difficult the achievement of desirable enrolment and literacy targets. The picture is even less bright for females. In 1960, 58 per cent of all illiterates in the world were women, while the corresponding figure for 1980 was more than 60 per cent. In fact, 70 per cent of the increase in the number of illiterates until the year 2000 would be contributed by females, mostly from the developing world. In general, more women will remain incapacitated by illiteracy than their male counterparts, except in Latin America.

The easiest interpretation for this alarming phenomenon is usually sought in the failure of the educational means to catch up with the expanding potential clientele for education. While this explanation may be partially correct, it presumes that there is indeed a universally increasing demand for education.

Unless economic and social changes increase the roles available to literate women, literacy will continue to be a luxury which many countries would aspire to, yet feel they could not afford, either economically or culturally. Seasonal literacy campaigns may periodically and momentarily prove useful, but the real, lasting solution to this problem will have to stem from a sustained demand for literate men and women generated by a balanced, wide-based process of socio-cultural and economic development.



ANNEX II

GEOGRAPHICAL COVERAGE AND REGIONAL GROUPS

All figures presented in this paper exclude Namibia, China and the Democratic People's Republic of Korea, for which the data available on enrolment were too sparse to allow projections. Furthermore, as the United Nations population estimates and projections by age exclude nations that had less than 250,000 inhabitants, these countries could not be included in the tabulations of enrolment ratios by country presented in the text. Estimates for these countries have, however, been included in the regional figures. The grouping of countries or areas into regions is shown below.

Developed countries:	All European countries, Australia, Canada, Israel, Japan, New Zealand, South Africa, the Union of Soviet Socialist Republics and the United States of America
Developing countries:	Rest of the world
Latin America and the Caribbean:	The Americas, excluding Bermuda, Canada, St. Pierre and Miquelon and the United States of America
South Asia:	Asia, excluding China, Democratic People's Republic of Korea, Hong Kong, Japan, Macau and Mongolia, Republic of Korea
Least developed countries:	Afghanistan, Bangladesh, Benin, Bhutan, Botswana, Burundi, Cape Verde, Central African Republic, Chad, Comoros, Democratic Yemen, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Lao People's Democratic Republic, Lesotho, Malawi, Maldives, Mali, Nepal, Niger, Rwanda, Samoa, Somalia, Sudan, Uganda, United Republic of Tanzania, Upper Volta and Yemen







G. Prospects for meeting the challenges posed  
by the aging of populations

United Nations\*

Introduction: demographic background

Although aged segments in the population have always existed, only in the last few decades has the attention of national societies and the world community been drawn to the social, economic, political and scientific questions raised by the phenomenon of aging on a massive scale. Prior to that period, while individuals may have lived to advanced stages of life, their numbers and proportion in the total society were not highly significant. The twentieth century, however, has witnessed success in many regions of the world in the control of perinatal and infant mortality, improvements in basic sanitary facilities and the control of infectious diseases. This combination of factors has resulted in an increasing number of persons surviving to later life.

Furthermore, from a demographic point of view, there will continue to be an increase over the next four decades in the absolute and relative size of the aging population in all regions and most countries of the world. This trend has started to emerge in a number of developing countries and will accelerate further at the turn of the century in all the developing regions. Although in some of the more developed countries the increase in the proportion of the aged is temporarily slowing down, developed countries are expected to resume or to continue to age considerably between the years 2000 and 2025.

In 1950, according to United Nations estimates, there were approximately 200 million persons 60 years of age and over throughout the world. By 1975, that figure had increased to 350 million. United Nations projections to the year 2000 indicate that the number will increase to 590 million and by the year 2025 to over 1,100 million; that is, an increase of 224 per cent since 1975. During this same period, the world's population as a whole is expected to increase from 4.1 to 8.2 billion or by 102 per cent. Thus, 45 years from now, the aging will constitute 14.6 per cent of the world's population.

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\* Centre for Social Development and Humanitarian Affairs, Department of International Economic and Social Affairs, United Nations.



It is significant to note that, for the more developed regions, the increase in the population as a whole is expected to be 16 per cent from 1975 to 2000 and 8 per cent from 2000 to 2025, while those aged 60 years and over will increase by 30 and 37 per cent during the same periods. In the less developed regions, the relative increase of the older population (60+) is even more pronounced; while increases of 63 and 41 per cent are projected for the total population over the same periods, the increase of those 60 years and over is projected to be 100 and 114 per cent respectively. Furthermore, it should be noted that, in 1975, slightly over half (52 per cent) of all persons 60 and over lived in the developing nations. Owing to the differential rates of increase, by the year 2000 over 60 per cent of all older persons of the world are expected to live in developing countries and it is anticipated that this proportion will reach nearly three quarters (72 per cent) by the year 2025.

The increase in the numbers and proportions of the aging is accompanied by a change in the population's age structure. Decreasing fertility, for example, entails a declining proportion of children in a population, which by the same token increases the proportion of older persons. Thus, according to the projections of the United Nations, the population aged less than 15 years in the developing regions is expected to decline from an average of about 41 per cent of the total population in 1975 to an average of about 33 per cent in 2000 and 26 per cent in 2025. In the same regions, the population of 60 years and over is expected to increase from 6 per cent in 1975 to 7 per cent in 2000 and 12 per cent in 2025, thus reaching the level that the more developed regions reached in the 1950s. In the more developed regions, the population below the ages of 15 is expected to decline from 25 per cent in 1975 to 21 per cent in the year 2000 and to 20 per cent in 2025. However, the group 60 and over is expected to see its proportion in the total population increase from 15 per cent in 1975 to 18 per cent in 2000 and 23 per cent in 2025. It should be noted that these are averages for vast regions and that there are considerable variations between countries and at the subnational level.

These structural changes are also reflected in the median ages of the population, which will increase rapidly from 1975 to 2025. In the less developed regions, they rise from 19.3 years in 1975 to 29.5 years in 2025, reaching the 1975 level of the more developed regions (30.4 years). For the developed regions the median age is expected to increase to 38.2 years.

It should also be noted that the sex ratio (that is, the number of men per hundred women) will continue to be an unfavourable one in the more developed regions of the world at the older ages, declining from 78 for the 60-69 groups to 53 for the over-80 group in the year 2025. In the less developed regions, it will decline from 94 for the 60-69 group to 73 for the over 80s in 2025. This imbalance is further aggravated by problems relating to widowhood, divorce and separation.

Another important consideration is the trend in urban-rural distribution. In the more developed regions, two thirds of the aged were in urban areas in 1975, and this projection is expected to reach three quarters by the year 2000. In the less developed regions, three quarters of the aged were to be found in rural areas. Nevertheless, the increase in the proportion



of the aged in the urban areas in these countries could be considerable and reach 42 per cent by the year 2000.

According to model life tables, the increasing life expectancies at birth could imply an increase in life expectancies at age 60 in the more developed regions of approximately one year between 1975 and 2025. In the less developed regions, this projected increase would be of roughly 2.5 years. Men of 60 could thus expect an average of over 17 years of further life in the more developed regions by 2025 and of over 16 years in the less developed regions. Women could expect about an additional 21 and 18 years, respectively.

#### The effect of the aging of population on development

Current demographic projections indicate that a world-wide aging of the population will continue, in both developed and developing regions throughout the remainder of the twentieth century. The growth in the population aged 60 and over and the decline in the relative number of children will significantly alter many social and economic institutions. Population aging need not cause severe economic hardships; neither, however, are reduced fertility and the associated changes in the age structure of the population likely to be a major stimulus to development. The potential adverse effects of population aging can be moderated by prudent public policies that reduce early retirement incentives and facilitate the work efforts of females.

#### Dependency ratios: effects and importance

Dependency ratios, which are one measure of a population's age structure, have been used as an indicator of the potential well-being of a nation. In view of the definition of the elderly as persons aged 60 years and over, these ratios are derived by dividing the number of young people (0-14 years) and the aging (60 years and over) by the population of working age (in this case, those aged 15-59 years). The principal argument is that a lower dependency ratio implies relatively more workers and that fewer resources need to be diverted to the dependent populations. Within this framework, the aging of the population in a society would be associated with increased economic potential, because the proportion of persons aged 15-19 years increases with the drop in the rate of population growth caused by the concomitant decline in fertility.

The apparently favourable effect of the aging of the population implied by the simple dependency ratio concept must, however, be further examined because other variables affect the size of the labour force. First, participation rates in the labour force vary greatly according to sex and age and are influenced by the level of fertility and stage of development. For example, the fertility declines that lead to an increase in the proportion of the population aged 15-59 years also tend to be associated with increases in the participation rate of females.

The rise in the proportion of females in the labour force is not conveyed by the population dependency ratio; the trend would tend to enhance the



favourable effects of population aging, but it might also reduce the nation's fertility rate still further.

The development process also affects the ages at which the population is economically active. As economic development proceeds, entry into the labour force is delayed in order for younger workers to obtain increased schooling and technical skills, and retirement at an early age becomes increasingly prevalent. Hence, the age limits of dependency are a function of development and economic growth.

Government policies clearly influence decisions made by married women, youths and the elderly with respect to labour supply. The economic dependency burden can be reduced by policies encouraging participation in the labour force.

In addition, the work environment could be redesigned to make it more attractive to older workers. A reduction of physical stress and the provision of jobs with more flexible hours would tend to encourage older persons to remain in the labour force. Developing countries may be able to prevent sharp declines in labour-force participation by the elderly by avoiding policies that encourage early retirement. Specifically, they could avoid lowering the age of eligibility for their maturing social security systems. Many developing countries already have a relatively low age eligibility for old-age benefits, however, and may need to consider raising these ages as expectation of life improves. By maintaining relatively high rates of market work by persons aged 60 and over, countries can substantially reduce the burden of income transfers for the elderly, which generally grows as the population ages.

In assessing the usefulness of dependency ratios and the seemingly favourable effects of population aging, a second issue to be considered is the relative cost of maintaining young and old dependants. In most developed countries, the income and health care of the elderly is, to a growing extent, provided through social security systems. The primary source of transfers to children remains the family, although schooling is usually provided by the State. The extent of public intergenerational transfers varies from one country to another, and in some societies the family remains the principal provider for young and old dependants.

While slowing population growth lowers the total dependency ratio, it increases the old-age dependency ratio. As a result, the relative cost of young and old dependants will determine the effect of population aging on total dependency costs. It has been estimated in medium-consumption profiles that in the less developed countries the consumption requirements of persons 65 years old and over exceed those of the group aged 0-9 years and are less than the needs of the 10-19 year age group. Clearly, the costs of supporting the elderly are a direct function of public policy. The higher the quality of care and the greater the level of income support provided for the elderly, the more significant the cost effect of population aging will be.

A final issue of the dependency-ratio concept arises from the fact that there are also significant changes associated with slowing population growth in the composition of each dependent group. As the rate of population growth



slows, increasing percentages of the elderly are found in the higher age groups, for example those over 75 years, and in a first phase the proportion represented by the cohorts of youths close to the age of entry into the labour force in the total number of the young tends to increase. These compositional changes may well increase the cost of supporting the elderly, since a higher proportion of the elderly is likely to require additional public services, while an increasing number of youths are ready for entrance into the labour market. The costs of supporting the very old are likely to increase with further declines in mortality rates at higher ages and with the advancement of increasingly expensive medical care.

In short, an analysis of the dependency ratio indicates that, in general, slowing population growth and the concomitant aging of the population raise the proportion of the economically active population and lower the dependency ratio. Declines in the age of retirement, higher costs for older dependants and the rise in the proportion of the very old may, however, offset this beneficial effect of population aging. As populations age, it is increasingly important to consider the long-term costs of modifications to retirement plans.

#### Migration and labour market mobility

Concern is often expressed about the implications of population aging on the age structure of certain geographical areas within countries. Migration occurs when people relocate in search of higher wages and better living conditions. Since migration rates fall with age, recent migration patterns have resulted in rural areas that have a greater proportion of elderly than do urban areas, an effect now seen in both less and more developed regions. A rural-to-urban migration of young workers, in conjunction with declining fertility, accelerates the aging of rural populations.

Aging of the population and a slowing of population growth will tend to retard economic adjustment across all industries. With an increasing population, there are a larger number of new entrants into the labour force to supply the manpower needs of expanding industries. In a stationary population, more of these new labour requirements must be met by drawing from the pool of existing workers. To facilitate the transition, retraining programmes for middle-aged workers is often a first important step.

The promotional prospects for workers are also retarded, since the rate of progress through the job hierarchy slows down as fertility declines. It has been postulated that population growth exerts the dominant influence on the rate of labour-force advancement; declining participation by the elderly in the labour-force tends, however, to offset this effect.

#### Investment, consumption and savings

The implications of population growth and aging for investment, consumption and savings are a much debated topic. One argument holds that, as fertility declines, more women will enter the labour force and aggregate output will rise, thus increasing consumption per capita. In addition, new



investment formerly needed to maintain the ratio of capital to labour can, in the presence of fewer entrants into the labour force, be used to raise the amount of capital per worker. Such an increase in the ratio of capital to labour would augment labour productivity and increase income and consumption per capita.

This analysis relies on the dependency ratio concept and suffers from its shortcomings. Conflicting theoretical and empirical analysis suggests that nations should not expect significant increases or decreases, especially in the short term, in per capita consumption associated with declining fertility rates. To detect significant differences in per capita consumption would be possible only if alternative states were to be observed after a lapse of many years. In societies whose populations are large enough to strain their physical and land resources, the cessation of population growth may significantly enhance the well-being of future generations.

The transition from a growing population to an aging one may result in shifts in demands for consumer goods and public services. For example, there will be a relative decrease in the demand for children-oriented goods and an increase in the demand for goods and services consumed by older persons. The evidence indicates that, across broad expenditure groups, slowing population growth will not significantly alter consumption patterns.

One question related to the change in per capita consumption concerns the influences of population aging on household savings. It is frequently suggested that the decline in the number of children per family will enhance the savings potential; but other forces tend to counteract this favourable effect of slowing population growth. First, expenditure on children can be considered as a form of savings or investment in human capital that will provide a future return either to the family or to the society. Second, expenditure on children may be at the expense of other consumption goods rather than savings. Third, the presence of children may alter the work patterns of their parents. In any event, potentially adverse effects of population aging on a nation's savings rate can be moderated by raising the retirement age to 68 or 70 in order to maintain a higher ratio of workers to non-workers.

In the light of these reservations and conflicting empirical and theoretical studies, it does not seem prudent to anticipate a significant increase in the savings rate in response to future demographic changes. The savings rate is a function of current and expected economic conditions and the anticipated real, after-tax, interest rate.

### Labour productivity

The labour productivity of an economy can be affected by population aging because the age composition of the labour force is altered. In order to be able to evaluate this effect, the productivity or ability profile of the whole working life must be known. In general, people enter the labour force with relatively little training and then, throughout their working lives, gradually acquire job skills and knowledge. At older ages, some of these skills may



begin to deteriorate, but the importance of the decline depends on the physical and mental demands of the job.

An understanding of this life-cycle pattern of human capital acquisitions, combined with an analysis of the changes in the age structure of the labour force, provides the criteria for assessing the effects of population aging on labour productivity. In the more developed countries, job requirements have become less and less physically demanding. The reduction in these requirements and the greater experience of older workers explain the research findings that older workers are frequently as productive as younger workers. On balance, the increasing numbers of older workers should not adversely affect labour productivity in the developed countries. In developing nations; where the work-load is often physically more burdensome, this conclusion may not be apposite.

A decline in the relative number of younger, less experienced workers should raise the average level of productivity. These workers are more likely to be unemployed as they enter the labour force and search for satisfactory employment. The aging of the population will reduce the proportion of the labour force composed of inexperienced workers and should also have a favourable effect on the nation's unemployment rate. It should thus have a favourable effect on labour productivity, especially if the economic response allows an increase in the ratio of capital to labour.

#### Care for the elderly

The most demanding economic problem associated with an aging population is the care needed by an increasing number of older dependants. The more developed countries have fashioned social security programmes to provide income transfers directly to older persons, along with supporting health-care programmes. Previous aging of the populations in these countries has required that larger shares of government budgets should be allocated to such programmes; thus, an increasing proportion of workers' current earnings has been taxed in order to support transfer programmes for the elderly. The expected continuation of the aging process will require even greater financial support in the future. The cost of these programmes can be reduced only by lowering benefits or reducing the number of beneficiaries.

In the developing countries, the onus of supporting older persons usually falls on the family. The addition of more older dependants to a family in a poor country can significantly alter the level of subsistence of other members of the family. As a result, the aging of the population may require that the Governments of these countries assume a greater share in support for the elderly. This support could be in the form of increased social services, such as medical care, subsidized housing, food supplements and cash transfers.



The effect of development on the aging of populations

Whereas the expected trebling of the world population between 1950 and 2025 has generated concern, the expected increase of the elderly by over five times during these 75 years has been almost unnoticed. The most spectacular increase projected is that of persons over 80. This group is expected to increase by a factor of 7.3, from 15 million to 111 million.

The forces making for these considerable changes can be briefly explained. The post-war high fertility resulted in an increase in the proportion of children and youth in the world population (the median age declined from 23.3 in 1950 to 21.9 in 1975), although the absolute number of the elderly increased. The median age thereafter rises to reach 26.1 years in 2000 and 30.8 years in 2025. Mortality at younger ages declined considerably during the post-war years. The greater number of children surviving thus reinforced the effect of the high fertility in making the population younger in a first stage. It is precisely the conjunction of these two trends that is at present hiding the subsequent aging in developing countries and will subsequently amplify it in them. However, in a later stage, this same large number of children born and responsible for this younger population age structure will themselves begin to join the ranks of the elderly after 2000, and by 2025 the elderly will be composed mostly of the survivors of those presently 15 to 35 years old. Establishing programmes for the future elderly, therefore, corresponds to a continuing concern for the youth of today. That is why, if the proportion of persons over 60 in the total world population is expected barely to increase between 1950 and 2000, it will jump by roughly 40 per cent between 2000 and 2025. The proportion of elderly can also be expected to continue to increase after that date.

Only in recent times, as a corollary to economic and technological advances in some parts of the world, with their vast social repercussions on productive life and personal living styles, has "aging" emerged as an issue, and the elderly as a separate and identifiable group with their own specific needs. Their numbers, in absolute and proportional terms, have also increased, due to concomitant advances in public health and other life-saving improvements at both extremes of the population structure.

This is also because aging is at the same time a sign of and a result of socio-economic development, in the quantitative as well as in the qualitative sense. One major example of the fundamental imbalance between the sectoral approaches to national and international development during the last decades has been the well established fact that advances in medicine and public health have by far out-paced similar progress in the fields of production, income distribution, education, housing, institutional modernization and social development in general terms. The less developed countries are in this sense about to age much too "early", because the other sectors necessary to ensure a balanced and integrated development process can hardly follow the same pace and guarantee a decent living standard for the dramatically increasing cohorts of elderly people which are foreseen for the next few generations. Nor can they be expected to adopt a system of obligatory retirement - even if the related costs could somehow be provided - for an aging population which will



not only expand in numbers, but also remain in better physical shape than previous generations.

Declining fertility and mortality rates portend significant declines in the proportions of the young and equally significant increases in the proportions of the elderly over the next few decades. The differential rate of increase of the various age groups is shown in the table, parts A, B and C. The only group for which an acceleration of growth is foreseen is the 60-plus. The decline is so dramatic for the pre-school age group that the relative weight of the 60-plus and pre-school will be symmetrically inverted between 1950 and 2025. Such structural changes need to be taken into account in long-term planning.

It has been argued that the elderly and the young compete as dependants for the fruits of development or the shares in socio-economic programmes. In strictly demographic terms (i.e., without considering activity rates or economic aspects), part A of the table shows that this argument may be faulty. Between 1950 and 2025, the 60-plus group is expected to increase its proportion in the total population by 5.2 points (from 8.48 to 13.68 per cent). During the same period, the population of working age, usually defined as the 15-59 group, is expected to increase by nearly the same number of points, i.e., 4.53. Therefore, the increase in the elderly will be nearly matched by that of the active age group. Meanwhile, the young dependants (0-14 group) are expected to decline by 9.73 points. This decline could enable a number of resources to be shared fairly between the two dependent groups in a manner satisfactory to both. As can be seen from the table, the period 1975-2000 is the most favourable for making the necessary plans, since the active group is expected to increase relatively the most (by 63 per cent). This is confirmed by the fact that if the calculations are conducted on the population structure of 1975 (instead of 1950), in which the active group represents 54.92 per cent of the total and the 60-plus represents 8.51 per cent, the increase in the active group between 1975 and 2025 of 6.37 points more than compensates for the increase of the elderly group of 5.17 points. However, this may turn out to be only a temporary advantage, since it is projected that after 2025 the elderly group may increase faster than the active age group.

For the less developed regions the results are similar to those for the world, or even better; but for the more developed regions, the already aged structure does not yield similar results. The increase in the proportion of elderly is not demographically compensated for by the active age group, which also decreases. In a way, the results are most relevant for the developing countries, since they show that the changes in age structure are favourable to the carrying out of both social and economic programmes. The costs of programmes created for the aging should also be seen against such a background.

#### Policy implications and recommendations

There are numerous and far-reaching policy implications that emerge out of the foregoing analysis of the aging of populations. These implications have been exhaustively delineated in the International Plan of Action on Aging



Table. Differential growth of various age groups, for the world, more developed and less developed regions, 1950-2025 (Percentage)

A. The world

Age group	Proportion of age group in total population in 1950	Inter-period growth		Proportion of age group in total population in 2025
		1950-1975	1975-2000 2000-2025	
0-4	13.44	59.26	21.77 4.94	8.43
5-14	21.32	75.78	28.74 11.66	16.60
15-59	56.76	55.87	63.50 37.52	61.29
60+	8.48	61.65	70.69 89.99	13.68
Total	100.00	61.02	50.47 33.92	100.00

B. More developed regions

0-4	10.23	1.70	2.11 4.61	6.72
5-14	17.55	26.25	-3.20 2.00	13.22
15-59	60.85	29.45	18.26 1.54	57.16
60+	11.37	75.54	38.76 36.89	22.90
Total	100.00	31.29	16.47 8.22	100.00

C. Less developed regions

0-4	15.03	78.52	25.52 5.00	8.78
5-14	23.19	94.20	36.46 13.31	17.29
15-59	54.73	70.30	82.30 47.22	62.10
60+	7.03	50.69	100.07 123.96	11.03
Total	100.00	75.69	62.96 40.62	100.00

Source: Based on estimates and projections of population by sex and age, 1950-2025, prepared by the Population Division of the United Nations.



which was adopted by the World Assembly on Aging during its deliberations from 26 July to 6 August 1982. The following is a summation of the recommendations of the International Plan.

The International Plan of Action on Aging noted that data concerning the older sector of the population - collected through censuses, surveys or vital statistics systems - were essential for the formulation, application and evaluation of policies and programmes for the elderly and for ensuring their integration in the development process.

In the same vein, household samples and other surveys and other sources of demographic and related socio-economic statistics provide important data for use in formulating and implementing policies and programmes for the elderly.

Accordingly, Governments and organizations that are in a position to do so should develop an information base which would be more specific than the "sixty-and-over" one now in use and which would be of help in planning the development of and solving problems concerning the aging of populations. The base could cover social, age, functional and economic classifications, among others. The establishment or improvement of existing information exchange facilities such as data banks in the field of aging, as well as the provision of technical assistance, when requested, would be essential aspects of this process.

Specifically, changing population age structures need to be monitored closely, at the national level, so that the appropriate and necessary policy changes can be made gradually and smoothly. For instance, implicit in the foregoing analysis of the impact of aging populations on dependency ratios is the idea that an aging population should, in general, be equated with later retirement.

Similarly, as the health standards of older persons improve, a gradual lifting of the retirement age should be considered by countries experiencing an escalation in the cost of social security programmes. Even though reduced expenditures on children may help to finance these programmes in the future, as social security taxes become larger, they may become more and more obvious objects of taxpayer resistance. They could lead to unnecessary social chaos and increased age-divisiveness.

With regards to rural-to-urban migration of the young, domestic policies need to be reviewed if population aging in the rural areas is a significant cause for concern. Governments can directly influence migration decisions. To the extent, for instance, that food subsidies artificially raise the real urban wage and depress farm earnings, more and more young people will seek to make a living in urban areas. Also, the quality of education and other public services can be altered to encourage younger people to remain in the rural areas.

The key to the foresight necessary to make the appropriate changes in a timely manner will be the availability of correct and up-to-date information and data on changing population structures. This means that policy-makers



must have access to information tabulated by sex, age groups (five-year intervals at least until 80 years of age), employment, income levels, living arrangements, health status and degree of self-care, among others. Such data could be collected through the census, micro or pilot census or representative surveys which should be treated as important prerequisites to all long-term planning and policy formulation and management at the national level.

In short, most countries are expected to age over the next few decades but they are not expected to age at the same speed or with the same intensity. Although each country follows its own distinct path, several patterns emerge with distinct policy and programme implications. There is a need to recognize the increasing heterogeneity among the countries and that beyond general policies and programmes, specific ones need to be tailored to meet the greater diversity of situations. In view of the developmental interrelations with aging and the insufficient degree of knowledge in this area, it is recommended that countries identify their particular path to aging, analyse its implications and elaborate the appropriate responses in the field of policies and programmes. It is also recommended that a long-term approach be adopted in view of the time-lag necessary to achieve results in this area and that sufficient stress be put on establishing a strong monitoring and evaluation system at the central planning level, if possible, in order to adjust to changes as they occur.



H. Selected aspects of population and development  
in the ECE Region

United Nations\*

Introduction

Since the adoption of the World Population Plan of Action, and partly as a result of it, the importance of the interrelations between population and development, including resources and environment, has come to be generally accepted. With the growing interest in and the rapidly increasing amount of research on these problems, the broad range and complex nature of the problems involved have also become apparent.

This paper addresses itself especially to one aspect of the problem, namely that of the economic and social implications of demographic trends and related policy issues in the Economic Commission for Europe (ECE) region. For this region the problem of the interrelations between population and development presents itself in a form different from that of the developing world. The most commonly shared characteristics of the region are low and declining population growth and comparatively high levels of economic and social development. A central question in the population-development problem of most, but not all, countries is, therefore, that of the economic and social consequences of slow and declining demographic growth associated with a progressive aging of the population.

It is not possible to deal exhaustively with even one relatively circumscribed aspect in one single document. The purpose of this paper, after a brief summary of the demographic background, is to review the state of knowledge in this area in very broad terms and to identify major substantive and policy issues.

The demographic setting

Population trends in the ECE region since the beginning of the 1970s can be summed up as the continuation of the long-term decline in growth to levels well below that for the rest of the world. The average annual growth rate for the decade of the 1970s was of the order of 0.8 per cent,<sup>1/</sup> which represented between one third and two fifths of the rate for the rest of the world. Even in the relatively short time-span of one decade this implied a fall in the share of ECE's population in the world total from 26.1 per cent in 1970 to 23.5 per cent in 1980. The trend in the 1970s was, as noted, only a phase in the long-term decline of the population growth in the region as a whole. The

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\* Economic Commission for Europe.



rate of 0.8 per cent per year for the decade compares with one of somewhat less than 1.1 per cent in the 1960s and with a projected growth of just over 0.6 per cent in the 1980s. Estimates and projections over a longer period reveal the same pattern: between 1950 and 2020 population growth in the region has been estimated and projected to fall from somewhat over 1.3 per cent in the 1950s to barely 0.4 per cent between 2010 and 2020, a reduction by about two thirds from the original level (see table 1).

Before taking up the issue of the economic and social implications of these trends and policy responses to them, two additional aspects should be mentioned. Whereas from a world-wide perspective the ECE region appears, with a few exceptions, to be a demographically homogeneous region, from a regional perspective substantial differences in past and prospective population trends exist. If countries are grouped in some broad classes as a function of current growth rates, the range observed is considerable. At one extreme are the countries with near zero growth and, at the other, those with annual growth rates of 2.5 per cent (see table 2). At the same time growth trends exhibit certain geographical patterns. All but four Western European countries fall within the class of low growth (less than 0.5 per cent).<sup>2/</sup> Half of the Eastern European countries and the Union of Soviet Socialist Republics belong to the group with intermediate growth rates (0.5 to 0.99 per cent). In addition, the growth rate for Poland is at the margin of the upper limit of this group. Most of the Southern European countries also fall in the group of moderate growth. As far as North America is concerned, population growth in the United States of America in the period 1975-1980 was in the higher range of the intermediate group, but that of Canada was substantially higher. Albania and Turkey have more in common, as regards their demographic characteristics, with developing countries than with the majority of those in the region. Finally, it may be noted that both Iceland and Ireland occupy a position substantially different from the other Western European countries.

These largely geographically determined differences in growth patterns imply significant variations in growth for the different sub-regions of the ECE. These differentials between sub-regions are projected to continue for the foreseeable future. Although the trends implied in the projections show for all sub-regions a decline in the rate of increase over the entire projection period considered (up to the year 2020), differentials between the sub-regions do not disappear and in fact remain fairly constant.<sup>3/</sup> By the second decade of the next century the growth of population is projected to be negative in Western Europe; around one half of one per cent for Eastern Europe and the USSR, as well as for North America, and slightly below one per cent for southern Europe (see Table 1). Fundamentally, the direction of demographic change and, presumably, its implications for economic and social developments within the region are similar. Nevertheless, there will be, as there are currently, differences of degree: the impact especially of the societal response to a sustained negative growth may differ substantially from that where population still increases, albeit slowly.

One of the major implications of the slowdown of population growth, and in particular the underlying decline in fertility, has been the progressive aging of populations (defined as an increase in the proportion of the population in the older age groups). It is not the purpose here to discuss in



Table 1. Population growth in the ECE region and  
sub-regions, 1950-2020  
(Percentage)

	Average annual growth rates					
	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10 2010-20
ECE region	1.32	1.07	.80	.73	.61	.46 .41
Western Europe	.76	.79	.34	.09	.07	-.08 -.12
Southern Europe	1.45	1.38	1.52	1.38	1.19	.94 .84
Eastern Europe and USSR	1.48	1.04	.85	.79	.60	.52 .45
North America	1.81	1.31	.91	1.00	.88	.63 .56

Source: Demographic Indicators of Countries: Estimates and Projections  
as Assessed in 1980 (United Nations publication, Sales No. E.82.XIII.5).



Table 2. Countries grouped according to levels of population growth, 1975-1980

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Rates of population growth  
(average annual percentage)

Under 0.5	Austria, Belgium, Cyprus, Denmark, Finland, France, German Democratic Republic, Germany, Federal Republic of, Hungary, Italy, Luxembourg, Norway, Sweden, Switzerland, United Kingdom (15)
0.5 - 0.99	Bulgaria, Czechoslovakia, Greece, Malta, Netherlands, Portugal, Romania, Spain, United States, USSR, Yugoslavia (11)
1.0 - 1.5	Canada, Iceland, Ireland, Poland (4)
Over 1.5	Albania, Turkey (2)

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Source: Demographic Indicators of Countries: Estimates and Projections as Assessed in 1980 (United Nations publication, Sales No. E.82.XIII.5).



detail the demographic aspects of aging in the ECE region; only some of its major features will be highlighted as a background to the discussion that follows.

From a world-wide perspective the aging of populations is most advanced by far in the ECE region. In 1980 the proportion of those aged 60 years and over in the region as a whole stood at 15 per cent, compared with less than 7 per cent for the rest of the world. The degree to which the population in the region has aged can also be gauged by the fact that whereas in 1980 the total population of the region represented, as noted, 23.5 per cent of the world's total, more than 41 per cent of those aged 60 years and over in the world lived in the region.

The rate at which the aging has progressed over the last three decades has been considerable: the share of the 60 years and over age group in the total population climbed from 11.6 per cent in 1950 to 15 per cent in 1980. Demographic projections show that this share will continue to grow for the rest of the century, albeit at a slower absolute and relative pace. The growth rate of the aged population is projected to slow down in the period from 1980 to 2000 to 1.4 per cent per year, against over 1.9 per cent per year between 1950 and 1980. However, since the overall growth of population is also expected to decline, the share of the aged population in the total will still increase substantially, from 15.0 to 17.3 per cent between 1980 and the year 2000.

The aging process in the region has been accompanied by two additional developments, which should be referred to briefly. First, the increase between 1950 and 1980 in the number of women aged 60 years and over was considerably higher (85 per cent) than for men (65 per cent), but this growth difference is projected to be reversed between 1980 and 2000 (40 per cent increase for men against 27 for women). In the second place, the aging process had been associated with a significant rise in the proportion of the very old (75 years and over). Between 1950 and 1980 the number of those 75 years and over increased by 127 per cent, compared with a percentage rise of 64 per cent for the 60-74 year-old age group. However, between 1980 and 2000 the growth of these two age groups will be more balanced.

Two factors related to the demographic dimensions of aging should be kept in mind when discussing the consequences of the process itself. First, the impact of aging will be easier to absorb if the process takes place gradually and over a longer period of time. As in the case of all societal change, adjustments may be more or less automatic if the changes themselves occur at a moderate and balanced pace. In general, the aging process in the majority of ECE countries has been evolving over a longer period and the comment on the pace of change may therefore have more relevance to those developing countries that are experiencing a rapid decline in fertility than to the majority of ECE countries. However, in many ECE countries aging has not proceeded at a smooth pace. Fluctuations or longer-term swings in fertility, mortality and international migrations have given rise to significant distortions in the age structure, including that of the aged population.



A second aspect related to the demographic process of aging is the well-known, but sometimes ignored, fact that the aging of populations involves not only an increase in the proportion of older people but, because of the underlying causes, also a fall in that of the young. Both theoretical models, as well as empirical data, bear this out. The aging process and its consequences should be considered, therefore, not merely as an evolution in a selected age segment, but as part of the structural transformation of the population as a whole, and, moreover, as a process associated with a slow overall increase of population.

Economic and social implications: a summary of  
the state of knowledge

The economic and social consequences of slow, zero or even negative population growth in combination with a progressive aging of the population have been widely discussed and it is not possible to review in detail the large, and still growing, literature on the subject. Only a selected number of aspects directly or indirectly relevant to policy issues will be discussed here.

A fundamental correlate of the interdependence of population and development is that, broadly speaking, a correspondence exists between the stage of population development and that of socio-economic development. Thus, high population growth and a young age structure are generally associated with low or moderate levels of economic and social development and, conversely, low growth and an aged population usually go together with high levels of economic and social development. The majority of ECE countries fall in the latter category and accordingly research on population-development interrelations in these countries has focused on these problems in a low-population growth, high-development setting. The approach to the analysis of interrelations between population and development in such a setting is not fundamentally different from that in assessing such interrelationships in the context of high-population-growth developing countries: in both cases the analysis of interrelations focuses on the determinants as well as consequences of population trends in relation to economic and social development.

Although in many aspects this common framework also implies a common focus on specific population-development issues, at the same time there are obviously differences as regards the specific population-development problems in the economically more advanced and the developing countries. Such differences exist not only as far as demographic factors are concerned, but also with respect to the development setting. The development process per se involves certain changes in economic structure, in the stock of capital and of human resources, in technology etc., which are independent of population factors or largely so. Obviously, an analysis of the economic impact of changing population trends is to a substantial degree conditioned by these factors.

Given these factors, the analysis of the effect of slow population growth and aging on development is basically not different from that dealing with the broader issue of the developmental impact of changing population size and



structure. Thus the implications of slow growth and aging on economic growth are usually assessed in terms of the impact on both the supply side, i.e., production, and the demand side, i.e., needs and consumption.

As already mentioned, the effect of the aging process is to raise simultaneously the proportion of the aged and decrease that of the young which tends to result in offsetting effects on the labour force potential, i.e., the population of working age. Data for the ECE region as a whole bear this out. In spite of the aging trend, the total dependency ratio (the number of those under 15 plus those 60 years and over per 1,000 persons in the 15 to 59 years age group) virtually did not change between 1950 and 1980 and is projected to remain fairly stable until the year 2000. In the period 1950-1980 an increase of the population aged 60 years and over of 77 per cent was associated with a rise of only 19 per cent for the under 15 years age group. The population in the central ages increased by 38 per cent, virtually the same as the total population (37 per cent) and, consequently, the dependency ratio barely changed, (from 635 in 1950 to 630 in 1980). Projected changes until the year 2000 are also relatively small: by the end of the century the dependency ratio is expected to increase to 645.

The consequences of slow population growth on the supply of labour, employment and economic growth is less clear. In the first place, the overall dependency ratio does not reflect the possible effect of changes within the working-age population on labour force growth. However, a calculation carried out for eight ECE countries comparing the growth of the population of working age with that of a standardized labour force (assuming constant 1960 activity rates for different sex-age groups) suggested that between 1960 and 1980 age changes within the working age population had a comparatively small effect (see table 3).<sup>4/</sup> In virtually all of these countries the impact of changes in labour force participation patterns outweighed by a considerable margin that of the demographic factors.

A review of trends in labour force and working-age population over the last two decades in 12 Western European countries and in Canada and the United States suggests, moreover, the absence of clear patterns of change in each of these variables between countries as well as over time (table 4).<sup>5/</sup> In the 1960 the increase of the population of working age exceeded that of the labour force (or the decline in working-age population was less than that of the labour force) in half of the 14 countries; the growth rates were identical in one country (Sweden) and in the remaining ones labour force increased more rapidly than the population of working ages. However, the 1970s saw a generally rising trend in labour force participation and, as a result, the labour force increased more rapidly than the working-age population in 9 of the 14 countries. Changes in female participation rates and, to a lesser degree, in the activity rates of men in younger and older ages were mostly responsible for these deviations of labour force growth from the trends in working-age population. The different magnitudes of such changes and, in turn, their timing explain the differences in patterns of change between countries.

Although the relationship between the growth of working-age population and labour force is, as these results show, not necessarily very close, it can



Table 3. Percentage growth of working-age population and standardized labour force, a/ for selected developed countries, 1960-1980

	Working-age population	Standardized labour force <u>a/</u>
Austria	3.71	7.53
Belgium <u>b/</u>	8.79	10.28
Canada <u>b/</u>	51.66	50.42
Denmark <u>b/</u>	12.07	14.31
Finland <u>b/</u>	16.75	18.76
France <u>b/</u>	19.79	22.20
Germany, Federal Republic of	8.60	13.33
Sweden	8.16	9.96

Source: Estimates of the ECE Secretariat.

a/ Calculated on the assumption of constant 1960 sex-age activity rates.

b/ 1960-1979.



Table 4. Growth rates of working-age population labour force and employment, 1960-1980  
(Average annual percentage change)

	1960-1970			1970-1980		
	Working-age population	Labour force	Employment	Working-age population	Labour force	Employment
Austria	-.16	-.53	-.45	.53	.60	.63
Belgium	.29	.67	.83	.62	.81	.21
Denmark	.77	1.29	1.41	.57	1.21	.33
Finland	1.01	.18	.14	.59	.66	.36
France	1.11	.80	.68	.80	.78	.37
Germany, Fed. Rep. of	.26	.11	.16	.56	-.05	-.33
Ireland	.23	.01	-.01	1.62	.97	.94
Netherlands	1.53	1.22	1.24	1.39 <u>a/</u>	.61	.19 <u>a/</u>
Norway	.70	.67	.71	.59	1.63	1.78 <u>b/</u>
Sweden	.67	.67	.69	.12	.99	.92
Switzerland	1.38	1.47	1.47	.51	-.34	-.18
United Kingdom	.22	.34	.25	.25	.40	-.03
Canada	2.29	2.54	2.63	2.08	3.17	2.97
United States	1.64	1.77	1.83	1.72	2.41	2.16

Source: Economic Commission for Europe, Economic Survey of Europe, 1982 (in press).

a/ Employment expressed in man-years.

b/ 1972-1981; Data are not comparable with earlier period.



be argued that in the long run a certain relationship must exist between the growth of the labour force potential (the population of working-age) and job opportunities (employment). It has been asserted, specifically for the United Kingdom but on general grounds, that in fact in a long-term perspective the population of working-age and employment have moved together on a more or less proportionate basis. At the same time, however, it was noted that in a shorter-time perspective this relationship does not necessarily hold and that actual deviations from the common trend might be protracted.<sup>6/</sup> Comparisons of the growth in working-age population and employment for the 1950s and 1960s confirm the existence of a fairly close association between the two. The correlation coefficients relating the percentage growth in working-age population in each country to its percentage growth of employment, based on data for 15 countries, were of the order of 0.83 to 0.87 both in the 1950s and 1960s. However, data for the 1970s lend support to the hypothesis that in spite of the broad association between the two, changes in working-age population and employment may diverge significantly. The correlation coefficient for the period between 1970 and 1980 was considerably lower (0.56) than in the preceding decades.

On the whole these results suggest that the relationship between the demographic trends as potential determinants of the society's labour supply, on the one hand, and the actual supply forthcoming from the population as well as the demand for labour, on the other, is not necessarily a close one, particularly in the shorter run. In addition, there is no assurance that the actual labour supply corresponds to the demand originated by the growth of the economy. It is obvious that during the 1960s labour shortages were a significant bottleneck to economic growth in a number of Western European countries.<sup>7/</sup> Likewise, in many Eastern European countries and the USSR, where high rates of economic expansion prevailed in recent decades, the slow growth of labour supply was felt to constitute a serious impediment to faster growth.<sup>8/</sup>

The problem of the consequences of the slow growth and the aging of the population for consumption and needs has, generally speaking, been dealt with from two perspectives: the impact on levels and patterns of household or private consumption and that on needs in specific sectors, including health, housing, education and social services. On the whole, most of the research on household consumption levels and patterns has led to the conclusion that the slowdown of growth and aging by themselves have only a relatively modest impact on consumption levels. Likewise, consumption patterns do not seem to be strongly affected, although of course the demand for certain items may change significantly. However, the conclusions may have to be amended somewhat if indirect effects of these population changes are taken into account. First, declining population growth usually implies not only changes in the age distribution, but also changes in household size and structure, important determinants of consumption. Some findings suggest that the effect of the changes in the number and size of households may offset, at least in part, the effect of age changes on consumption. Another indirect effect of slow population growth and aging on consumption may result from the higher level of per capita income, which is usually assumed to result from these demographic changes. Higher income would raise consumption as well as, for that matter, investment.<sup>9/</sup>



The fact that demographic factors influence the demand in such sectors as housing, health and education has been widely recognized. Both slow population growth and the aging of populations may be expected to affect both the level and type of such services. The magnitude of the effects is not always clear. Slower population growth will by itself have the tendency to slow down the demand for housing but, as already mentioned, it is also likely to affect the number of families. If, in addition, account is also taken of the changing levels of income, as well as changing attitudes and tastes of both the aged and young (for instance, a preference for maintaining or establishing their own household), the outcome becomes less evident. Sharply rising divorce rates should lead to an increased demand for housing. Nevertheless, the impact of demographic factors per se seems to be fairly well established and this is also true for other sectors. For instance, the age-cost profiles of the health sector have been found to have a clear J-shape, decreasing after the youngest ages, but rising steeply during older ages.

The significance of the sectoral aspects of the consequences of demographic trends is enhanced by the fact that in the typical developed country, the major responsibility for the provision of a broad range of social services (including health, education, social security, income maintenance, social services) lies with the public or state sector. The role of the family (in its different forms) in catering to these needs has declined substantially, although possibly not to the extreme, as is sometimes suggested. The full dimension of problems that may arise as a result of the expanded role of the Government has not yet been fully explored. For one, few studies exist that have attempted to assess the integral impact of demographic factors on services provided by the Government or State.

Although, as noted, the study of the problems of low growth and aging of population departs basically from the same framework as the more general issue of the impact of population growth and age structure, there can be differences of emphasis between the two. The question of the impact on the public sector, referred to above, is one. Also in the analysis of slow population growth and aging, more attention is being given to the less tangible factors in economic growth (i.e., productivity, entrepreneurship, mobility, adaptability to new conditions) on the assumption that the economy becomes less dynamic and increasingly inflexible as the population ages and its growth stagnates. Many of the arguments, which are based on insufficient and difficult to provide empirical support, are inconclusive. Although the arguments on either side are difficult to prove, it should be recalled that the so-called intangible factors have been shown to be among the most important determinants of economic growth and progress in the past.

A review of the literature on the implications of the combined or separate effects of slow population growth and aging reveals the existence of considerable differences of opinion and, in fact, opposing views. Whereas some stress the negative consequences of these demographic trends, others take a more optimistic view and argue that on balance the implications of these trends may not constitute a serious hindrance, if any at all, to economic and social development. These differences of opinion are to a large extent a consequence of the complexity of the problems involved, but in part can also be attributed to the assumptions and methods of analysis.



With respect to the latter, the first point that can be made concerns the treatment of the demographic variables. In a recent critical examination of this and other aspects, W. Serow noted that in most cases the empirical work has taken as a point of departure either a hypothetical stationary or stable population.<sup>10/</sup> Few studies, he noted, consider the consequences of sustained negative growth and only a few others have taken into account what appears to be the likelihood of fluctuations and variations in the growth and structure of population. An exception is the study by Wander, which notes that the low fertility in Europe has not evolved as a regular trend towards stationary population, but as a result of fertility rates fluctuating around replacement levels for a longer period. Wander further argues that there is "nothing to suggest that birth rates eventually will stop fluctuating".<sup>11/</sup>

A second weakness of many of the studies undertaken is the sometimes overly simplistic manner in which variables other than demographic are treated. Serow observes that many of the empirical results available are based upon economic models which deal with only one or a few indicators and assume *ceteris paribus* conditions for the others. He cites as one example of a frequently found restrictive assumption, that of constant, or at most, exogeneously determined labour-force participation rates. It should be recognized that some of these limitations are difficult to overcome in practice - e.g., projecting, in the context of the longer-term demographic outlook, national or per capita income over a similar time span in order to relate the two is obviously very problematical. Nevertheless, this is not infrequently done and although the restrictive nature of the assumptions are referred to, their importance in determining the results is only sporadically pointed out. Taking as an example the impact of a slowdown in population growth and aging on the costs of the public sector, it is obvious that the result of such an exercise will be quite different if one assumes a growth of income or product of 5 per cent or so (rates typical for the 1960s) or one of 1 to 2 per cent (those prevailing at present).<sup>12/</sup>

An additional issue, also mentioned by Serow, is that frequently the conclusion is reached that certain structural rigidities have to be removed in order to offset possibly adverse effects of demographic change. Often, Serow noted, the difficulties faced in bringing about such changes are underestimated or ignored. It may be added that it is not necessary to go so far as to argue, as some do, that the stagnation of population growth and aging itself creates these rigidities. However, it may well be that both these demographic trends and the structural rigidities and lack of adaptability have at least some causes in common and, therefore, are closely associated with each other.

Empirical quantitative studies represent only part, and until recently a minor part, of the work carried out on the subject discussed here. Much of the literature deals with the problems of slow population growth and aging only in qualitative terms. The coexistence of opposed views on the consequences of these demographic changes can at least in part be explained by this fact. The weight of qualitative arguments, for instance, the comparative effect on productivity and economic growth of a mobile but inexperienced young labour force and that of an experienced but less mobile older labour force, is difficult to assess in the absence of empirical work.



In spite of some of these limitations, the present state of knowledge has been an important factor in increasing the understanding of the nature of the problems involved and their multidimensional characteristics. It has also been a significant influence in creating awareness of the far-reaching policy implications of demographic developments.

#### A short-run view

In assessing the population-development interrelations in the ECE region, it should be recognized that recent years have seen a significant shift from long-term problems to short-run issues. The major explanation for this shift has been actual developments.<sup>13/</sup> Since the early 1970s economic trends, as they had emerged after the Second World War, changed radically. Economic growth since then has slowed down in nearly all of the countries of the ECE region and even stagnated in some. Concern with an economic recovery in the near future has become predominant and questions related to longer-term issues have been relegated to a secondary place.

Whereas from the perspective of population, the long-term view of its interrelations with economic and social development is the most essential, under the present circumstances the short-run view cannot be ignored. In the case of the ECE region, an increasing concern with prospects for the shorter-run problem is, to a considerable extent, justified by current population trends and prospects for the immediate future.

Although it can be argued that in most developed countries population growth may be expected to fluctuate within fairly narrow limits, this is not true as far as changes in the age structure are concerned. Due to past fluctuations in fertility, mortality and international migrations, recent trends and the prospects for the decade of the 1980s reveal sharp fluctuations in the age structure which are bound to have significant economic and social implications.<sup>14/</sup> In addition, although little is known concerning the effect of economic fluctuations on demographic factors, there is evidence that both nuptiality and fertility respond at least to some extent to business cycles.<sup>15/</sup> Considering the severity of the current recession, if such an effect exists it may have a substantial influence on demographic developments at present and in the coming years.

The magnitude of these variations can be gauged from the changes in working-age population during the last half of the 1970s and the two half-decades of the 1980s. Table 5 presents data based on United Nations estimates and projections of the working-age population for the ECE region as a whole and its different sub-regions. For the former, the average annual increase of the number in working ages was just below 7 million in the period 1975-1980 and will be of the same order of magnitude in the first half of the 1980s. However, in the following five-year period annual growth is projected to drop by nearly 40 per cent, to just over 4 million. Even more marked are the changes in some of the sub-regions, especially Western Europe and North America. In the first region the average annual absolute increase in the number of those in working ages in 1980-1985 is some 60 per cent higher than it was in the 1975-1980 period, but in 1985-1990 the average increase will be



Table 5. Average annual change in working-age population  
(Thousands)

	1975-1980	1980-1985	1985-1990
ECE region	6,989	6,958	4,269
Western Europe	1,091	1,632	281
Southern Europe	1,324	1,423	1,296
Eastern Europe and USSR	2,306	2,360	1,628
Northern America	2,268	1,543	1,064

Source: Demographic Indicators of Countries: Estimates and Projections as Assessed in 1980 (United Nations publication, Sales No. E.82.XIII.5).



only one sixth as large. In the case of North America the average annual increase, which was still over 2.2 million in 1975-1980, will fall to 1.5 million in the second half of the decade. In Eastern Europe and the USSR a slowdown will not manifest itself until the latter part of the decade and in Southern Europe, whose demographic evolution differed and still differs from that in the rest of the region, average annual increases in the number of the population of working age will remain fairly uniform for the whole period considered.

Data for the broad age group, as those for the region as a whole, conceal in turn substantial differences in the evolution of individual age groups. Of special interest, from the point of view of labour supply, are the changes in the younger ages, representing potential entrants into the labour markets and, in the more advanced ages, reflecting the possible magnitude of the outflow of workers through retirement or death. Data for the same period and sub-regions as in table 4 but relating to these two age groups are presented in table 6. The extent of variation is obvious from these estimates and projections.

Fluctuations in the younger ages reflect, in particular, the substantial variations in fertility trends during the recent decades. Different trends for the various sub-regions reflect the different timing and extent of fertility changes. The difference in trends from 1980 to 1985 between Eastern Europe and the USSR on the one hand, and Western Europe, on the other, is mainly due to the fact that the decline of fertility in the East preceded that in the West. The full impact of the fertility decline also manifests itself in North America in the current five-year period and becomes even stronger in the last half of the 1980s. In contrast in Western Europe the major effect will not occur until the 1985-1990 period. Finally, in Southern Europe a drop in the average annual increase is shown between 1975-1980 and 1980-1985, but after that the number changes comparatively little.

Trends in the older age groups are more difficult to interpret since they respond not only to possible fertility differentials and fluctuations in the past, but also to the nearly life-long mortality and migration experience, including the disturbances caused by war. Again, fluctuations are very pronounced. For the ECE region as a whole the period 1980-1985 stands out when compared with the other two periods, with an average annual increase in numbers of more than five times. With the exception of North America, the current five-year period is one of very high increases in all sub-regions. Especially important is the average annual increase from virtually nothing to more than 2 million between the last half of the 1970s and the first half of the 1980s in Eastern Europe and the USSR. A slowdown is projected for all sub-regions in 1985-1990, with actual declines in Western Europe and North America.

The magnitude of the fluctuations in the age distribution described above are not duplicated in many parts of the world, although in certain developing countries deficient age data or incomplete knowledge of past demographic trends may conceal important fluctuations. Even so, in a setting of sustained population growth the possible effect of any such disturbances may be of less importance. In the large majority of the countries in the ECE region the



Table 6. Average annual change in population aged 15-24  
and 55-64 years  
(Thousands)

	1975-1980	1980-1985	1985-1990
<u>15-24 years</u>			
ECE region	1,455	-1,372	-1,952
Western Europe	524	263	-674
Southern Europe	424	173	131
Eastern Europe and USSR	177	-1,138	-543
Northern America	330	-670	-866
<u>55-64 years</u>			
ECE region	692	3,500	638
Western Europe	172	753	-127
Southern Europe	157	469	311
Eastern Europe and USSR	33	2,131	638
Northern America	330	147	-184

Source: Demographic Indicators of Countries: Estimates and Projections as Assessed in 1980 (United Nations publication, Sales No. E.82.XIII.5).



evolution of the age distribution outlined above is associated with, and in fact partly a consequence of, low or at most moderate population growth. The implications of this combination of sharp age-distribution fluctuations and slow population growth are not yet clearly known or even perceived.

However, there can be little doubt about the fact that by themselves sharp fluctuations in the age distributions imply complex problems from an economic point of view. A relative over-supply of potential young workers, at least in the present economic setting in Western Europe and North America, may, for instance, turn into an acute shortage of new entrants into the labour market within the next few years (assuming that economic conditions improve). Likewise, the present high potential outflow of older workers from the labour force, further reinforced by declining participation rates, may be the source of serious pressures on the economy through the social security systems, and may result in increased participation rates for older workers as social security programmes are forced to raise the age of retirement in order to remain solvent, and may also have adverse effects on the social programmes for the aging population. The magnitude of the changes suggested by the above selected data and the, comparatively speaking, high speed with which they occur, impose a high degree of flexibility on policy-making to adjust to these demographic changes. This at a time when, for economic and other reasons, a strong demand for temporary adjustments and structural changes already exist.

#### Summary

Whereas the growing concern with short-term problems does not seem unjustified in the light of current conditions and trends, to the extent that it overshadows longer-term considerations, certain long-run issues will be ignored or receive less attention than they deserve. Among the questions that are not likely to receive full consideration is that of the prospective trends in population.

By the end of the century, according to United Nations projections, practically half of the ECE countries will have negative or zero population growth.<sup>16/</sup> By the end of the second decade of the next century some 10 countries would be experiencing an annual decline in their population of close to or over 0.5 per cent. The process of the aging of populations will be accentuated during most of this period.

It would seem obvious that these prospective demographic developments will create policy problems of a dimension not much less than those currently faced by developing countries, which are experiencing an excessive population growth that also threatens their future.

The economic and social consequences of the projected demographic trends will be one important element in shaping a policy response. A better knowledge of those consequences will be essential for the most appropriate choice of policies.

The identification of the type and scope of knowledge most needed for policy purposes is equally important. The preceding short and much less than



complete summary suggests that probably the major impact of the demographic trends will be felt in the public or state sector.

In so far as knowledge on the implications of population trends in this sector is fairly limited, high priority should be assigned to this area of knowledge based on an approach that integrates the different dimensions of the problem, incorporating both long-term and short-run considerations.

This does not mean that improvement of the state of knowledge of current and projected population trends should be restricted to the public sector. Better knowledge of its impact on the private sector is also needed. Such an approach will make it possible to accept or reject the assumption that the major consequences of these demographic trends manifest themselves in the public sector. Significant policy implications would follow from the corroboration or rejection of this hypothesis.

If it were true, as most findings suggest, that slow population growth and aging have comparatively little effect on the private sector, there are no grounds to assume that families and households will change patterns of reproductive behaviour and thus bring about an increase in fertility for economic reasons.

Under these circumstances, a well-designed and effective government population policy will become essential if the reversal of the demographic trends is considered desirable.

#### Notes

1/ As the ECE region includes most, but not all, more developed countries, this rate of growth practically coincides with that of the "more developed regions" used in the United Nations population projections. The rate for the ECE region is slightly higher because it includes some countries, Turkey in particular, that still have a comparatively high rate of growth.

2/ The sub-regional classification used by ECE differs in several respects from that found for the population estimates and projections. Western Europe includes both the Northern and Western European countries as well as Italy. Southern Europe, apart from excluding Italy, includes Cyprus and Turkey.

3/ The exception is Southern Europe; the difference between the growth rate for this sub-region and the average for the ECE region is projected to narrow considerably between 1980 and the year 2020.

4/ In the two countries where the difference was significant (Austria and the Federal Republic of Germany), the major factor was not a change in the age distribution, but a strongly imbalanced sex distribution in 1960 which normalized itself gradually in the two following decades.



5/ See also Economic Commission for Europe, Economic Survey of Europe in 1982, section 1.6(i) (in press).

6/ M. Beenstock and P. Werburton, "An aggregate model of the UK labour market", in Oxford Economic Papers (New Series), vol. 34, No. 2, (July 1982), pp. 235-275.

7/ The case of these countries may serve as an illustration of the possible indirect effect of slow population growth on subsequent economic growth. The labour shortage in the 1960s was probably one of the factors responsible for the rapid increase in wages, which contributed to the profit-squeeze and ultimately to the slowdown of economic growth. The downward inflexibility of wages may in turn have been one of the factors that depressed economic growth in the 1970s.

8/ The problems caused by the slow growth of the labour force were already discussed in the early post-war economic plans of a number of Eastern European countries and the USSR. See, for instance, Economic Commission for Europe, Economic Survey of Europe in 1959, (United Nations publication, Sales No. 60.II.E.1) Chap. 3, pp. 3 and 6.

9/ See, for instance, D. Eilensteine and J. Cunningham, "Projected consumption patterns for a stationary population", in Population Studies, vol. 26, No. 2, (July 1972) pp. 223-231; J. Espenshade, "How a trend towards a stationary population affects consumer demand", in Population Studies, vol. 32, No. 1 (March 1978), pp. 147-158.

10/ W. Serow, "Socio-economic implications of changing age composition of low fertility countries. Empirical evidence: an assessment, in particular, of its practical significance", paper presented at the IUSSP International Population Conference, Manila, 1981.

11/ H. Wander, "Zero population growth now: the lessons from Europe", in T. Espenshade and W. Serow, The Economic Consequences of Slowing Population Growth, (New York, Academic Press 1978), pp. 42-44.

12/ Many of the studies made in the 1960s and early 1970s assumed, for instance, high rates of economic growth, reasonable for that period but unrealistic in the light of developments since then.

13/ To what extent this change was reinforced by a recognition of the inherent limitations of long-term forecasts is not clear. The unpredictability of "shocks", starting with the oil crisis of 1973, may have been an additional factor.

14/ As already noted, it has been pointed out by Wander that there is no convincing argument that fluctuations in the birth rate will stop automatically.

15/ See, for instance, D. Kirk, "The influence of business cycles on marriage and birth rates", in A.J. Coale, (ed.), Demographic and Economic Change in Developed Countries (Princeton, New Jersey, 1960) pp. 241-257.



16/ Demographic Indicators of Countries: Estimates and Projections as Assessed in 1980 (United Nations publication, Sales No. E.82.XIII.5).







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